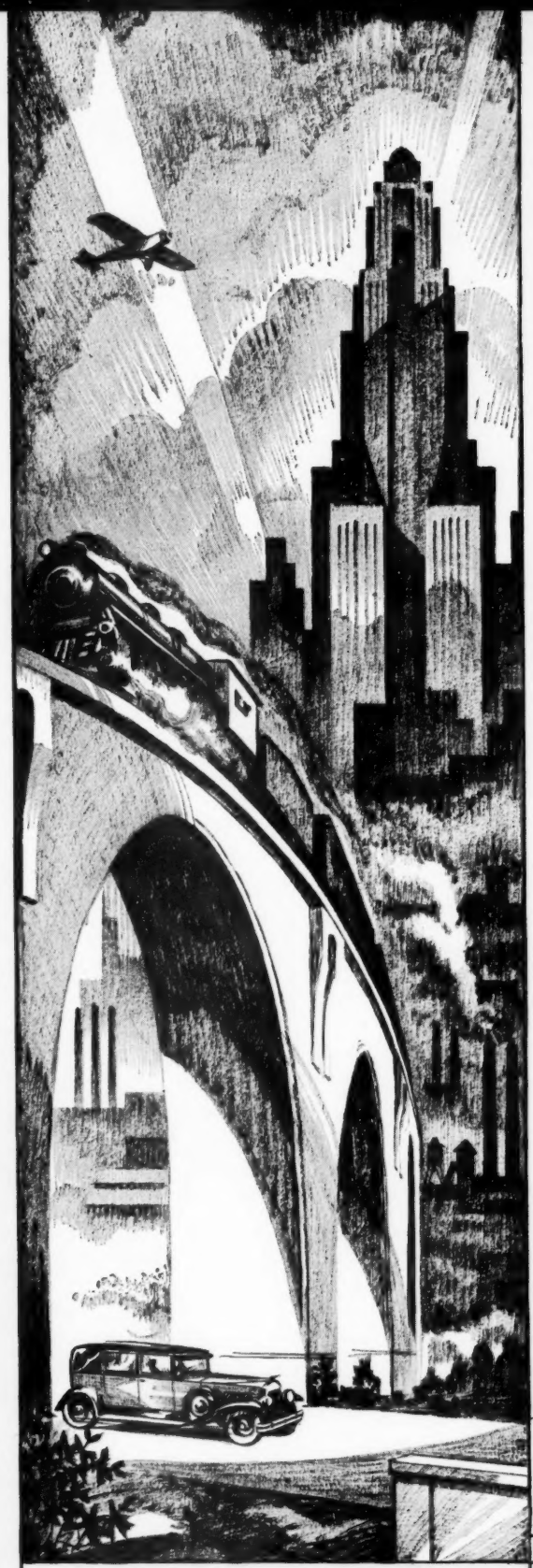
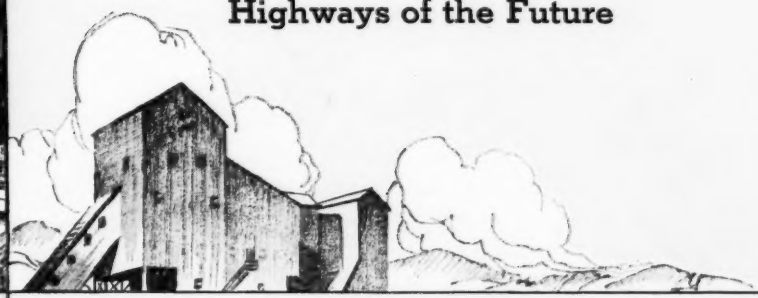


# The CRUSHED STONE JOURNAL

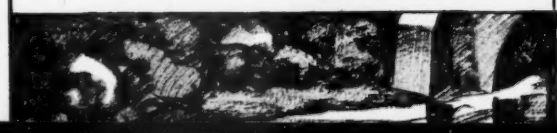
## In This Issue


- Twenty-First Annual Convention
- Uses for Quarry Fines
- Uses for Agricultural Limestone
- Report of the Committee on Agricultural Limestone
- Standardization of Stone Sizes
- Recent Trends in Accident Occurrence at Quarries
- Highways of the Future


January-February · 1938

Official Publication
NATIONAL CRUSHED STONE ASSOCIATION

## Technical Publications

*of the*

## National Crushed Stone Association, Inc.

◈

BULLETIN No. 1

The Bulking of Sand and Its Effect on Concrete

BULLETIN No. 2

Low Cost Improvement of Earth Roads with Crushed Stone

BULLETIN No. 3

The Water-Ratio Specification for Concrete and Its Limitations

BULLETIN No. 4

"Retreading" Our Highways

BULLETIN No. 5

Reprint of "Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey" with Discussion

BULLETIN No. 6

The Bituminous Macadam Pavement

BULLETIN No. 7

Investigations in the Proportioning of Concrete for Highways

BULLETIN No. 8

The Effect of Transportation Methods and Costs on the Crushed Stone, Sand and Gravel, and Slag Industries

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BULLETIN No. 10

Stone Sand

***Single copies of the above bulletins are available upon request.***

Manual of Uniform Cost Accounting Principles and Procedure for the Crushed Stone Industry ($2.00 per copy)

# The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED STONE ASSOCIATION

1735 14th St., N. W.
Washington, D. C.

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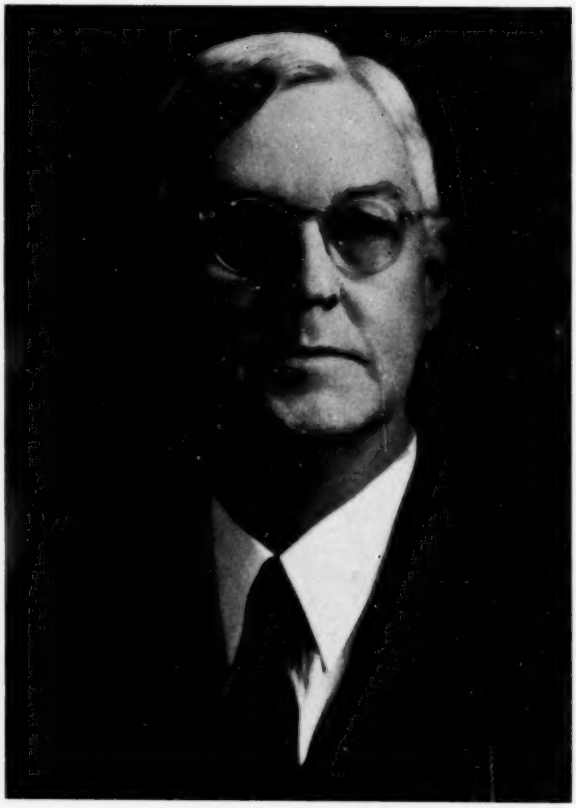
## Contents

| | Page |
|---|---|
| Twenty-First Annual Convention | 3 |
| Uses for Quarry Fines —A. T. Goldbeck | 11 |
| Use of Agricultural Limestone Under Agricultural Conservation Program —C. C. Farrington | 18 |
| Report of the Committee on Agricultural Limestone | 22 |
| Standardization of Stone Sizes —Albert V. Bratt | 23 |
| Recent Trends in Accident Occurrence at Quarries Producing Crushed Stone —W. W. Adams | 27 |
| Highways of the Future —Wm. F. Callahan | 30 |



**T. I. WESTON**

**President, Weston and Brooker Company, Columbia, S. C., who was elected President of the National Crushed Stone Association at its Twenty-first Annual Convention held in Cincinnati, Ohio, in January.**

# THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

Vol. XIII No. 1 JANUARY-FEBRUARY, 1938


# Twenty-First Annual Convention Enthusiastically Acclaimed an Outstanding Success

SOME four hundred delegates from all sections of the country gathered in Cincinnati on January 24, 25 and 26, to make the Twenty-first Annual Convention of the National Crushed Stone Association a thoroughly enjoyable and instructive event, characterized to an unusual degree by a fine spirit of good fellowship and helpfulness. Not for years have the business sessions of the convention enjoyed such excellent attendance and the interest the various papers presented commanded was strikingly demonstrated by the desire on the part of the delegates actively to participate in the various discussions which were scheduled. The social side of the meeting was likewise thoroughly enjoyed and included as the principal events the Greeting Luncheon on Monday, the Presidential Reception and Annual Banquet on Tuesday, and the Convention Cabaret on Wednesday, the last night of the Convention. A gratifyingly large number of ladies were present and from all reports seemed well pleased with the special program which had been arranged for their pleasure.

No one could have been present at this annual meeting without realizing the many advantages which flow from concerted, organized effort and that no matter what may be the problems which lie ahead, their possibilities of solution are greatly enhanced through utilization of the collective intelligence of an entire industry, as expressed through its national trade organization.

The following brief report concerning the highlights of the convention is given largely for the information of those who found it impossible to attend.

◆ **T. I. Weston, President, The Weston and Brooker Co., Columbia, S. C., elected President. H. A. Johann, The Frog, Switch & Mfg. Co., St, Louis, Mo., replaces Max Lambert as Chairman of the Manufacturers' Division. Norman E. Kelb elected to membership on the Executive Committee. Program of interesting papers covering wide variety of subjects is well received. Manufacturers' Division Exposition is considered one of the best in Association history.**

In this and subsequent issues of the *Journal* there will be printed those papers of unusual interest and value, which were presented before the Convention.

## T. I. Weston Succeeds Henry Rodes as President

The entire membership will heartily endorse the selection of the Convention at its business session on Wednesday afternoon in unanimously electing T. I. Weston of The Weston and Brooker Co., Columbia, S. C., as President for the ensuing year. Glowing tribute was paid to Henry Rodes for his outstanding service to the Association during his two years as President. Mr. Russell Rarey, Chairman of the Nominating Committee, dramatically expressed the thoughts of all when, in giving his report, he said, in part "One year ago the Nominating Committee and the Convention in their concurrence with the recommendation of the Nominating Committee showed wisdom and good judgment in the election of President Rodes to succeed himself for a second year. In his two years as President of the Association Henry Rodes has contributed very definitely to the success of the Association. Meanwhile he has endeared himself to us all to a degree even greater than we knew before.

"If I were to write a thumbnail sketch of the history of Henry Rodes in his administration as President of the Association, it could be contained in these few words: Henry Rodes—capable gentleman, with emphasis on both words.

"In considering a possible successor to Mr. Rodes the Committee had no difficulty in reaching an early and unanimous choice. The candidate we offer for your consideration is also a capable gentleman, capable we know him to be because of the success he has had in his own business and in his private life; gentleman we know him to be because of his unfailing gracious manner and his kindly consideration for the opinion of others.

"Long a member of the Association, long a Regional Vice-President, and long a member of the Executive Committee of the Association, our candidate is the logical and natural choice for President. Gentlemen, on behalf of the Nominiating Committee, I offer for President of this Association the name of Mr. T. I. Weston of South Carolina."

Amid enthusiastic applause Mr. Weston was unanimously elected and, upon the request of the chair, J. A. Rigg of West Virginia and Col. L. J. Boxley of Virginia escorted the President-elect to the platform.

In words appropriate to the occasion Mr. Weston graciously acknowledged the honor which had been conferred upon him and pledged his best efforts to continuing the work of the Association during the coming year.

To fill the vacancy resulting from the elevation of Mr. Weston to the presidency, W. T. Ragland of the Raleigh Granite Co., Raleigh, North Carolina, was made Regional Vice-President for the Southern Region. In electing members to the Board of Directors R. P. Immel, American Limestone Co., Knoxville, Tennessee, was chosen to take the place of Mr. Thomas McCroskey at the latter's request, and Harold R. Brownson, recently elected President of the Massachusetts Crushed Stone Association replaced Bernard A. McKinney. With these two exceptions all members of the Board were re-elected for the current year.

NORMAN E. KELB
*Elected to the Executive Committee.*

At a meeting of the newly elected Board, following the close of the Convention, Norman E. Kelb, Ohio and Indiana Stone Co., Indianapolis, Indiana, was elected a member of the Executive Committee to replace E. Eikel of New Braunfels, Texas, who had indicated his inability to serve for another year. All other members of the Executive Committee were re-elected, making its personnel for the present year as follows:

| | |
|---|---|
| T. I. Weston | Russell Rarey |
| Otho M. Graves | H. E. Rodes |
| N. E. Kelb | Stirling Tomkins |
| E. J. Krause | A. L. Worthen |

## H. A. Johann Elected Chairman of the Manufacturers' Division

As he has long been identified as a Vice-Chairman of the Manufacturers' Division, it was particularly appropriate that that group, at its meeting held during the Convention, should elevate to the chairmanship H. A. Johann, The Frog, Switch & Mfg. Co., St. Louis, Mo. Mr. Johann has been a regular attendant at our conventions for a great many years, is well and favorably known throughout the industry and should make a real contribution to the Manufacturers' Division during the coming year. In addition to the election of Mr. Johann as Chairman, the following Vice-Chairmen and Directors were elected:

VICE-CHAIRMEN

J. Barab, Bradley S. Carr, J. Harper Fulkerson, Frank B. Ungar, Roy Wills

BOARD OF DIRECTORS

H. A. Johann, Chairman, Frog, Switch & Mfg. Co., St. Louis, Mo.
J. Barab, Hercules Powder Co., Wilmington, Del.
Bradley S. Carr, American Manganese Steel Division of The American Brake Shoe & Foundry Co., Chicago Heights, Ill.
F. E. Finch, Hardinge Co., York, Pa.
J. Harper Fulkerson, Cross Engineering Co., Carbondale, Pa.
E. J. Goes, Koehring Co., Milwaukee, Wis.
H. T. Gracely, Marion Steam Shovel Co., Marion, Ohio.
C. S. Huntington, Link-Belt Co., Chicago, Ill.
Kenneth Jensen, Kensington Steel Co., Chicago, Ill.
M. S. Lambert, Robins Conveying Belt Co., Chicago, Illinois.

Albert E. Reed, The W. S. Tyler Co., Cleveland, Ohio.
S. R. Russell, E. I. du Pont De Nemours & Co., Wilmington, Del.
Bruce G. Shotton, Hendrick Mfg. Co., Pittsburgh, Pa.
L. W. Shugg, General Electric Co., Schenectady, N. Y.
John Swenehart, Atlas Powder Co., Wilmington, Del.
P. C. Tennant, The Texas Co., New York City.
S. W. Traylor, Traylor Eng. & Mfg. Co., Allentown, Pennsylvania.
Frank B. Ungar, Ludlow-Saylor Wire Co., St. Louis, Missouri.
Roy Wills, Lima Locomotive Works, Inc., Lima, Ohio.
F. O.Wyse, Bucyrus-Erie Co., South Milwaukee Wis.

The excellent work of Mr. Max Lambert, Chairman of the Division during the past year, was appropriately recognized and the grateful appreciation of the Division was extended to him.

## Reports of Regional Vice-Presidents on Business Conditions

The reports of the Regional Vice-Presidents on business conditions during the preceding year and the outlook for the coming year have more and more become an important feature of the opening session of the Convention, and because of the widespread interest of these summaries, they are given in full as follows

### Report for the Eastern Region

(Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware and Maryland)

By A. S. Lane, John S. Lane & Son, Inc., Meriden, Conn., Regional Vice-President.

(In the absence of Mr. Lane whose health did not permit his attendance, A. L. Worthen presented his report)

The Eastern Region is so large and consequently conditions vary so much in different parts of it that it is exceedingly difficult to name any one figure or set of figures which will reasonably cover the region as a whole.

From such replies as I have received, it appears that in southern New England the tonnage of 1937 is from ten to fifteen per cent better than in 1936, with prices holding fair and firm. I have no direct replies from Metropolitan Boston District, but understand in a general way that demand has been light and prices unstable. New York, New Jersey and Pennsylvania quarries indicate that both the tonnage and prices have been under 1936 by around ten per cent.

Replies from all parts of the region indicate that production has been about 50 per cent of capacity.

Most of the quarries throughout the region seem to expect about the same tonnage, with prices a little lower if anything in 1938 than those of 1937.

H. A. Johann
*Elected Chairman of Manufacturers' Division*

Pennsylvania quarries particularly lament the fact that slag and gravel are now admitted by the State Highway department almost exclusively for repairs of primary roads, which feature has a very decided bearing on the stone tonnage.

The diversion of the gasoline tax in most of the states, too, has had a most depressing influence on the stone business, as so much of the road building funds formerly came from that source.

In closing, may I say that it is a matter of much regret to me that my health is not such that I can be at the convention again this year, and I am off to Florida tomorrow. I have heard glowing reports of the gathering last year, and hope that it will be even more interesting and helpful this year, with a still larger attendance.

### Report for the Central Region

(Michigan, Indiana, Ohio, Kentucky, West Virginia and Virginia)

By J. A. Rigg, Acme Limestone Co., Ft. Spring, West Virginia, Regional Vice-President.

Reports from six of the seven Directors in the Central Region, representing a fair cross section of the Region, were received and this report is based on the data contained in those reports.

The volume of crushed stone business in this territory during 1937 as compared with 1936 ranged from a 25 per cent increase to a 30 per cent decline. However, the majority of the reporters showed an increase. I would judge from these reports that there was an average increase in volume throughout the region of ten per cent over 1936, but without a corresponding increase in net profit. Price levels seemed to be about the same, one reporter stating

that prices were slightly lower, one slightly higher. I might say that the fact there was no corresponding increase in net profit was due to increased cost not being compensated for by an increase in prices.

The relationship of volume to capacity seems to have averaged about 50 per cent. There were isolated cases where plants operated 100 per cent, and some plants furnishing chemical and metallurgical stone seem to have had a good volume, but no plant seems to have had more business than it could take care of, and the majority operated from 30 to 50 per cent of capacity.

An average of the figures submitted indicates the distribution of business for various purposes to be as follows:

| | |
|---|---|
| Highway Construction | 51% |
| Railroad Ballast | 12% |
| Building Construction | 7% |
| Chemical and Metallurgical Stone | 19% |
| Agricultural Limestone | 4% |
| Miscellaneous Items | 7% |

However, due to the small number of reports which we have to base our report on, necessarily, I don't think that those figures mean a great deal. They may be a very fair average, and again they may not.

As to the outlook for 1938, the indications are that highway construction will be about the same as that in 1937. In the event railroads are granted a general increase in freight rates, ballast business should be much better. If the present business recession continues there will be a heavy decline in the demand for material used in general building construction. Otherwise, the latter half of the year should see a fair demand for crushed stone in this line. The indications are that there will be a falling off in the demand for chemical and metallurgical stone during the first half of the year, and the ultimate demand for the season will depend entirely on a material improvement in business conditions. Under the stimulation of government subsidy, there will probably be some increase in the demand for agricultural limestone.

With business conditions as they are and the strong resistance throughout the country to price increases of any kind, it is hard to see where we can expect any material increase in prices for the year 1938.

In brief, it would seem that the year 1937 has been a fairly good one from the standpoint of volume, but disappointing in profits. Producers generally are not pessimistic; neither are they very optimistic, and most of them are inclined to believe that we will go along at about the same pace for 1938 as we have for 1937.

### Report for the Northern Region

(Montana, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin and Illinois)

By N. E. Kelb, Ohio and Indiana Stone Co., Indianapolis, Indiana, Regional Vice-President.

I have written to the Directors in this region and some of the producers, but because of the size of the region, information from about half of the states is entirely lacking. I have received reports from Missouri, Illinois, Iowa and Wisconsin.

From these reports, I would judge that the volume of crushed stone business in 1937 was just about the same as in 1936. Several of the reports state that the price level was lower. They are stressing particularly business being lost to WPA operated plants and governmental competition. That seems to be true in Missouri, Iowa and Wisconsin, more so than in Illinois.

Two reports state that the price level was just a wee bit higher. Just guessing as to what the average for the territory might be, I would say that the price level is the same for '37 as for '36, which would mean that with the increases of costs that have taken place, profits have suffered.

Apparently most plants have operated at about 50 per cent of capacity. The per cent of output going into different usages varies so greatly that not much conclusion can be drawn, agricultural limestone varying in some instances from zero to 30 per cent; highway construction and railroad ballast varying from 15 to 70 per cent, so that the individual's report, of course, is colored by whether or not he had a large job near his plant.

None of the people reporting even want to make a guess for 1938. Of course, with the President urging that the highway program be reduced, that leaves that question up in the air, with it being anybody's guess as to what the volume of rail business might be—and I suppose we could guess just as well as the boys in Washington and not miss it any further. But the feeling seems to be that the '38 tonnage will be slightly under '37, probably with more optimism prevailing near the latter part of the year as to metropolitan construction, railroad ballast, etc.

Apparently there is no relief in sight from government operated plants, and the price level, according to the reports, is slipping off a little bit.

### Report for the Southern Region

(Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama and Mississippi)

By T. I. Weston, The Weston and Brooker Co., Columbia, S. C., Regional Vice-President.

The scope of this report doesn't give information from Florida, Alabama and Mississippi. There is no stone produced, as far as I know, in Mississippi, and very little in Alabama. The Florida producers are not affiliated with the Association. Their material is entirely different from what we generally know as crushed stone.

Tennessee reports an increase of business for 1937 over 1936 of from 10 to 18 per tent. North Carolina reports an increase of 15 per cent, while South Carolina and Georgia report sales about the same.

Prices held to about the same but were a little lower in Tennessee, Georgia and South Carolina. In North Carolina prices were approximately 8 per cent lower.

The region estimates the production around half the plant capacity.

Tennessee reports that highway construction consumed from 20 to 30 per cent of sales; railroad ballast 40 to 50 per cent; agricultural limestone, 20 to 30 per cent; and other uses 5 to 10 per cent.

North Carolina, South Carolina and Georgia report that some 60 to 80 per cent went into highways; 10 to 25 per cent for railroad ballast; and 5 to 15 per cent for building construction and miscellaneous uses.

Opinion in the region seems to be in agreement that sales for 1938 will be down slightly. It is expected that the distribution will be approximately in the same percentages for the various uses as in 1937.

Producers in areas where there are scattered stone outcroppings fear increasing competition from roadside plants on account of various governmental agencies. Perhaps also freight rates will increase roadside production.

### Report for the Southwestern Region

(Oklahoma, Arkansas, Texas and Louisiana)

By E. Eikel, Servtex Materials Co., New Braunfels, Texas, Regional Vice-President

(Last minute developments made it impossible for Mr. Eikel to attend the Convention; consequently his report was presented by his son, Mr. E. O. Eikel)

There was less crushed stone produced by reporting companies in 1937 than in 1936, and it is believed that for the region as a whole output decreased in 1937.

Prices were somewhat lower last year than during the preceding year, and consumption is estimated to have been roughly equal to 30 per cent of plant capacity.

The 1937 production of the Region distributed about as follows:

| | |
|---|---|
| Highway Construction | 65% |
| Railroad Ballast | 25% |
| Building Construction | 4% |
| Chemical and Metallurgical Uses | 5% |
| Agricultural Limestone | 1% |

Tonnage produced in 1938 should distribute approximately the same as that marketed in 1937.

Prospects for this year are not good. A lighter demand than was experienced last year is anticipated, with the price trend being downward.

Increased freight rates will have the effect of causing less rail shipped crushed stone and more locally produced material, of inferior quality as often as not, to be used. The higher rates are certain to work a very severe hardship on established plants so located as to be tied to the rails, and that such plants will be able to survive for long is extremely doubtful.

### Report for the Western Region

(California, Nevada, Utah, Colorado, Arizona and New Mexico)

By A. J. Wilson, Granite Rock Co., Watsonville, California, Regional Vice-President.

(In the absence of Mr. Wilson, his report was read by Mr. Boyd)

The outlook for crushed stone business in Northern California during the calendar year 1938 would make it appear that volume will be approximately the same as in the year 1937. In the San Francisco area, sales of crushed stone products should be greater during 1938 due to the fact that considerable construction work will be contracted for the Golden Gate International Exposition in 1939. Slack business is expected for the first three months of this year, although producers are of the opinion that a normal increase in volume will occur during the summer and fall months.

Railroad ballast requirements should show an appreciable increase over 1937 in the event that the requested rate increases are granted.

You realize, of course, that any business forecast for this year must be merely guesswork, as business sentiment depends largely upon friendly cooperation between the Federal Government and the business world.

Please express my regret that I shall be unable to attend your Convention, and sincerely trust that I may have the pleasure of seeing you all in January, 1939.

## Reports of Executive Directors

Following the presentation of the reports by the Regional Vice-Presidents, A. T. Goldbeck, Engineering Director of the Association, presented his report entitled, "What Our Laboratory Tests Have Shown During 1937." After briefly summarizing the various activities engaged in by the Bureau of Engineering, Mr. Goldbeck devoted his discussion to describing two of the more important investigations which have been conducted in the laboratory during the past year. The first series of tests described involved investigations of stone screenings for stabilized base construction and the second concerned itself with the effect of shape of particle on the mortar-making properties of stone sand. As the results of these investigations will shortly be sent out to the membership in a separate report, no attempt will be made to describe them in any detail at this time.

In his report, Administrative Director J. R. Boyd outlined the principal activities—other than those concerned with the routine administration of Association affairs—which had been handled by the Administrative Director's office during the past year. A summary of these activities is now being prepared for distribution to the membership in the immediate future. Mr. Boyd laid emphasis upon the need for cooperative effort through the National Association in effectively presenting the industry's viewpoint to Congressional committees and various other Governmental agencies. It will be gratifying to the membership to learn that in concluding his report he stated that the financial condition of the Association was stronger than it had been for many years and that through intensive field work, aided by the cooperation of active members, gratifying increases in membership had been accomplished.

## Relations of Government to Industry

Many phases of this highly important problem were discussed by various speakers on the Convention program. In a paper entitled, "What is the Future of Private Enterprise," Donald D. Conn, Executive Vice-President, Transportaton Association of America, gave a most interesting and comprehensive analysis of the situation as it exists today. Last year we were privileged to reprint in the *Journal* a discussion on this subject by Mr. Conn and, as he covered substantially the same points before the Convention, we refer those who are particularly interested in Mr. Conn's observations to the previous article.

At the Greeting Luncheon on Monday Pyke Johnson, Vice-President and Washington Representative of the Automobile Manufacturers' Association, discussed "The Washington Outlook as it Affects Industry." Mr. Johnson gave a realistic and highly interesting analysis of legislation pending before the Congress which was exceptionally well received by those present. At his request his remarks were strictly "off-the-record" and it was consequently necessary to be present to receive the benefit of his discussion.

On Wednesday morning Henry D. Sayer, Manager, Casualty Department, Association of Casualty and Surety Executives, addressed the Convention on the subject, "The Occupational Disease Problem in the Crushed Stone Industry." The question of compensation for occupational diseases is becoming a more and more important one, particularly in view of the trends in state legislation along these lines. Much valuable information was contained in his discussion of the subject and it should be given a careful reading by all members of the industry when it appears in full in *The Crushed Stone Journal.*

Aware of the increasing responsibility of business to declare itself on matters which vitally concern it, particularly in view of the barrage of attack upon industry by Government spokesmen to the effect that industry has not cooperated with the administration in a proper effort to stop what is known as the present recession, President Rodes, substantially in advance of the Convention, appointed a Committee on the Relations of Government to Industry, whose task it was to consider such Federal legislation existing or proposed as affects the crushed stone industry and to express the opinion and declare the attitude of our industry towards such legislation. Otho M. Graves was named as Chairman of this Committee which included Messrs. E. Eikel, E. J. Krause, Russell Rarey, J. A. Rigg, Stirling Tomkins, T. I. Weston, A. L. Worthen and Harold Williams. After devoting many hours to the task assigned both before and during the Convention period, the Committee finally

drafted the report and it was printed and submitted in tentative form to the Convention on Wednesday afternoon for such action as might be deemed advisable.

That the crushed stone industry takes seriously its responsibility to express itself on such vital questions was clearly indicated by the extensive discussion which took place during the presentation of the report by Chairman Graves. After Mr. Graves explained in detail a number of the bills covered by the report, it was unanimously and enthusiastically adopted by the Convention with the request that copies be sent to all members of the industry and that they be asked specifically in an appropriate accompanying letter to make known to their congressmen and senators their viewpoint on the various legislative proposals. Just before going to press with this issue of the *Journal* we mailed copies of the report of the Committee on the Relations of Government to Industry, as finally adopted by the Cincinnati Convention, to each member of the industry as of record in the Washington office. In order that the action of the Convention can be made most effective it is urged that all crushed stone producers immediately make their views known to their representatives in Congress.

## Technical Discussions

In this field five outstanding papers were presented before the Cincinnati meeting. An important contribution to the field of knowledge relating to damage resulting from quarry blasting was made by J. R. Thoenen, Supervising Engineer, Non-Metal Mining Section, Mining Division, U. S. Bureau of Mines, in a progress report entitled, "Ground Vibrations from Quarry Blasting", in which Mr. Thoenen outlined the results to date of an investigation of this matter now being conducted by the Bureau of Mines. The data already obtained from this investigation is of such fundamental importance to crushed stone producers that Mr. Thoenen has indicated his willingness to prepare a summary of his remarks made at Cincinnati which will be published in an early issue of the *Journal*.

For many years efforts have been made to bring about stone size standardization and we were particularly fortunate in having A. V. Bratt, Testing Engineer of the Massachusetts Department of Public Works, give us his viewpoint on this highly important matter. From a background of many years' experience Mr. Bratt made a careful analysis of the subject and his thoughts should prove of very real value in our further efforts to bring about greater uniformity in crushed stone sizes. There is given elsewhere in this issue Mr. Bratt's full discussion.

Mention has already been made of Mr. Goldbeck's paper, "What Our Laboratory Tests Have Shown During 1937." In addition to that paper he presented on Tuesday morning a discussion on "The Uses for Quarry Fines." In this paper Mr. Goldbeck points out many uses for quarry fines and shows how such material may be disposed of at a profit. His observations are printed in this *Journal*, and should prove enlightening to those faced with the problem of disposing of what has too frequently been considered a waste product.

In view of the rapid acceptance by state highway departments of the Los Angeles Rattler Test, no crushed stone producer can afford not to familiarize himself in detail with the excellent paper by F. H. Jackson, Senior Testing Engineer of the U. S. Bureau of Public Roads, entitled, "The Correlation of the Los Angeles Rattler Test and Service Behavior." Because of the widespread interest in this subject, his discussion will be printed in full in an early issue of the *Journal*.

To the crushed stone operator contemplating today or likely to contemplate the installation of diesel electric power the discussion by Lacey H. Morrison, Editor of *Diesel Power*, entitled, "Diesel Power in the Crushed Stone Industry," should prove of exceptional value. Mr. Morrison made a careful and comprehensive analysis of the various factors to be considered and his paper constitutes a most valuable contribution to our knowledge in this rapidly developing field. At an early date we shall publish the full text of Mr. Morrison's paper.

Due to unavoidable circumstances Wm. F. Callahan, Commissioner, Massachusetts Department of Public Works, was unable to present his scheduled paper on the program entitled, "Highways of the Future." He sent a most able substitute in the person of Raymond W. Coburn, Construction Engineer of the Department. We are indebted to Mr. Coburn for a thoughtful discussion of that interesting subject. His paper is printed in this issue of the *Journal*. "The Effects of Economic and Social Changes upon Cost" was very ably discussed by A. D. Berning, Resident Partner, Ernst and Ernst, New York City, and we anticipate that this discussion will be carried in a subsequent issue of the *Journal*.

## Labor Relations Clinic

One of the most absorbingly interesting discussions of the Convention took place on Wednesday afternoon in the form of a Labor Relations Clinic, the discussion being led by Stirling Tomkins of the New York Trap Rock Corp., New York City, and N. E. Kelb of the Ohio and Indiana Stone Co., Indianapolis, Indiana. These gentlemen recounted in detail their experiences in this field during the past year. Their observation proved most enlightening and should be of material assistance to those who had the privilege of participating in this discussion. A more comprehensive report of the "clinic" is not possible as the entire discussion was "off-the-record."

## Agricultural Limestone

In view of a number of basic changes contemplated in the administration of the Soil Conservation and Domestic Allotment Act during 1938, the paper by C. C. Farrington, Assistant to the Administrator of the Agricultural Adjustment Administration, entitled, "The Use of Agricultural Limestone in the Revised Soil Conservation Program for 1938," proved particularly illuminating. We are publishing it in full in this issue of the *Journal*. It will be noted that towards the conclusion of Mr. Farrington's paper reference is made to Section 7 of the 1938 Agricultural Conservation Program Bulletin. A number of weeks before the Convention President Rodes appointed a Committee on Agricultural Limestone, under the chairmanship of Russell Rarey, for the purpose of drafting a statement for presentation to the Agricultural Adjustment Administration expressing the point of view of agricultural limestone producers concerning the administration of Section 7. This committee met during the Convention period and the statement as finally drafted and presentd to the Administration is given immediately following Mr. Farrington's discussion. We urge agricultural limestone producers to familiarize themselves with the contents of both documents.

## Accident Prevention

We are especially indebted to Mr. W. W. Adams, Supervising Statistician, Employment Statistics Section, U. S. Bureau of Mines, for his excellent analysis of accident statistics in the crushed stone industry dating back to the inauguration of our safety contest in 1926 which he presented on Wednesday morning under the title, "Recent Trends in Accident Occurrence in Crushed Stone Operations." Mr. Adams' study in this regard should prove highly informative and do much to aid the industry in waging its constant war against accidents. Because of the permanent value of the material included in Mr. Adams' paper, we are giving it in full text elsewhere in this issue.

Following the presentation of his paper, Mr. Adams, in behalf of the Director of the U. S. Bureau of Mines, presented the safety awards in the National Crushed Stone Association Safety Contest for 1936. To the winner of the contest, the Krause No. 1 quarry of the Columbia Quarry Co., located near Columbia, Illinois, he presented *The Explosives Engineer* trophy which was received in behalf of the Columbia Quarry Co. with appropriate remarks of acceptance by Mr. Elmer Heise, Safety Engineer. To each of the other plants having completed the year with no lost-time accidents, a parchment reproduction of *The Explosives Engineer* plaque was awarded as honorable mention in the contest. Full details concerning the results of the contest were given in the Sept-Oct-Nov. 1937 issue of *The Crushed Stone Journal*.

## Manufacturers' Division Exposition

It was generally thought by all present that the Manufacturers' Division Exposition was of exceptional merit and value. Participated in by forty exhibitors occupying sixty-four booths, it was exceptionally well attended from the formal opening on Monday evening until its close at the conclusion of Wednesday afternoon. The success of the Exposition was in large part due to the excellent handling of this affair by Mr. L. W. Shugg, Director of Exhibits. We take this opportunity of extending to Mr. Shugg and to his organization, the General Electric Co., the deep and sincere appreciation of the Manufacturers' Division and of the Association at large.

## Social Features Prove Popular

The high spot of the entertainment program took place on Tuesday evening when the Annual Banquet was held, preceded by the customary Presidential Reception. The wisdom of shifting the Annual Banquet from Wednesday evening to Tuesday evening was eloquently attested by the presence of more than twice as many delegates as participated in this event last year and without any noticeable sacrifice in attendance at the Convention Cabaret which was shifted to Wednesday evening.

(*Continued on page 17*)

# Uses for Quarry Fines[1]

By A. T. GOLDBECK

Engineering Director,
National Crushed Stone Association

◆ **Quarry fines too frequently have been treated as waste products having little value. In the present paper many successful uses for quarry fines are pointed out and it is shown how this material may be disposed of at a profit.**

FOR the purpose of the present discussion the term "quarry fines" will be applied to those products of crushed stone production smaller than approximately ½ inch. These products may be stone screenings containing the dust of fracture, dirty stone screenings containing not only dust, but some extraneous material also such as clay or overburden, clean prepared stone sand and dustless screenings. These products may, of course, be used in different ways and they are not all equally suitable for the different uses described.

It is difficult to say definitely what percentage of the total production of a crushed stone operation will result in "quarry fines" as above defined. Much depends upon the demand for the various intermediate sizes. However, the tonnage of fines produced is large and its profitable disposal is important in any crushed stone operation. Consequently, a consideration at least of the ways of using quarry fines holds promise of value.

There are several characteristics of quarry fines which should be emphasized because of their peculiar influence on the effectiveness of this material for certain uses. Particles which result from a crushing operation are characterized by their angularity. This is an important property, for when angular particles are brought together in a compacted bed or layer, these angular particles seek a position in relation to one another which causes them to interlock and thereby internal movement of the mass is produced only with difficulty. Thus, the angularity of the stone is a real asset in aiding the stability of a mass of this material irrespective of any other influence. Stability also is aided by the inherent cementing properties of the finest particles of stone dust. All fine stone dusts possess this cementing property to some extent. This is so even with particles of finely ground silica. Limestone and trap rock dusts, however, have cementing properties to a marked degree after they have been wetted and are allowed to dry. The fine rock powders thus tend to cement the coarser particles of rock together and they materially aid in increasing the stability of a well compacted, dense mass of screenings. This cementing property of limestone and dolomite dust is enhanced by the action of sodium and calcium chloride in the presence of water because of the soluble effect of these salts in solution on these types of rock.

In order to be systematic, the various uses for quarry fines will be discussed under separate headings.

## Quarry Fines in Base Construction

Quarry fines are ideal for the construction of highway bases and several ways of using them are available.

*Subgrade Treatment.* When the subgrade consists of plastic clay which becomes muddy in wet weather, it is common practice to mix a sufficient amount of sand with the clay to create a dense, stable mass. The clay in this case serves to bind the sand particles together and to render the mixture impermeable to water. Neither the clay nor the sand is stable when used alone, yet when combined in proper proportions a stable layer is produced. Quarry fines including stone screenings, stone sand or quarry waste can be used in lieu of natural sand and will give excellent results when properly used. There is one big difference, however, between quarry fines and natural sand, namely, that the quarry fines generally possess inherent stability because of their shape and their natural cementing properties. It thus would seem unnecessary to use clay mixed with quarry fines, for in most cases the clay is not needed to create stability in the quarry fines and it may greatly detract from the stability if too much is used.

Without at present discussing in detail the required gradation of particles in quarry fines for use

[1] Presented at the Twenty-first Annual Convention of the National Crushed Stone Association, at Cincinnati, Ohio, January 25, 1938.

in stabilizing a clay subgrade, let it be said that if the screenings are mixed with the clay, a mixture of maximum density, one having the greatest weight per cubic foot should be obtained. It is safer, however, to underfill rather than overfill the voids with clay, especially if a bituminous wearing surface is to be used. Many sand-clay roads which remained stable when untreated have become unstable when surface treated with bituminous material, merely because evaporation was thus retarded or stopped and capillary moisture accumulated and created instability.

Most screenings will contain enough dust to create a dense, well cemented layer without any clay additions and hence it would appear that the most economical way of using stone screenings on a clay subgrade is *not* to use them as an admixture in an attempt to stabilize the clay, but rather to use them as an additional layer possessing high stability and capable of carrying heavy wheel loads. If too little stone dust is present, some clay or fine soil may have to be added.

Because of the high stability of a screenings layer this material may be and has been used with very great success on shifting, unstable sand subgrades. Clean sand is notoriously unstable when it is dry. A layer of screenings when laid on clean sand is effective in carrying wheel loads because:

(1) It aids in maintaining enough capillary moisture in the sand to help hold the particles of sand together in much the same manner that beach sand is rendered stable after the recession of the tide; and

(2) A layer of screenings distributes the wheel load and by virtue of its weight it exerts some surcharge effect, thus helping to confine the sand in place.

It can be stated definitely that a layer of stone screenings containing the dust of fracture forms an excellent treatment when used over a clay or shifting sand subgrade and it is capable of carrying heavy traffic loads. It is not to be regarded as a wearing surface, but merely as a sub-base or a base course. As pointed out in another paper before this convention, our tests show us that to get the best results the screenings should contain sufficient dust to make for high density. The proper gradation naturally will vary depending upon the maximum size used. The following gradations based on Fuller's curve of maximum density should give excellent results and are to be regarded as "ideal" gradations which probably can only be approximated with screenings as produced:

*Total Per Cent Passing*

| | | | | |
|---|---|---|---|---|
| ¾ in. | 100 | — | — | — |
| ½ in. | 77 | 100 | — | — |
| ⅜ in. | 65 | 82 | 100 | — |
| No. 4 | 47 | 56 | 64 | 100 |
| 8 | 38 | 42 | 47 | 64 |
| 16 | 32 | 36 | 38 | 46 |
| 30 | 26 | 30 | 32 | 38 |
| 50 | 21 | 24 | 26 | 33 |
| 100 | 17 | 20 | 22 | 29 |
| 200 | 15 | 17 | 19 | 25 |

It seems important that, in so far as practicable, the percentages of dust through the No. 200 sieve be adhered to for the best results even though the stone dust content must be augmented by the additions of clay or silt. Stone dust, however, is a more desirable material than clay because of its low degree of plasticity when wet. As the soil technicians would express it, stone dust has a low P. I. or Plastic Index value.

### Screenings Used With Admixtures

*Calcium Chloride.* Those who advocate the use of admixtures of calcium chloride with soils or with aggregates for the purpose of making stabilized bases, base their claims of the efficacy of the calcium chloride on several facts. Calcium chloride is a hygroscopic and also a deliquescent material. A hygroscopic material is one which readily absorbs and retains moisture. Deliquescence consists of entering into solution and becoming liquid through the attraction and absorption of moisture from the air. Also, it is known that moisture films surrounding finely divided particles act as a binding medium for cementing these particles together. The particles of clean sand at Daytona Beach are so tightly held together by moisture that a hard, highly resistant speedway results. Likewise, a solution of calcium chloride has a lower vapor pressure than water alone. This means that a solution of calcium chloride will evaporate slower than water. Hence, it is believed that beneficial effects are obtained when calcium chloride in solution is applied to a screenings surface because the mosture films will be retained to the extent necessary to have them serve to bind the particles together. When calcium chloride is used with screenings, the gradation should be the same as advocated for a plain screenings layer. The screenings are first applied, shaped to proper cross-section and rolled, preferably when the screenings are in a moist condition. The calcium chloride is then ap-

plied in flake form at the rate of 3/4 to 1 lb. per sq. yd. followed later in the season by ½ lb. per sq. yd. Such a surface has excellent load supporting value and there should be comparatively little loss of material under traffic so long as enough calcium chloride is used to keep the surface moist.

*Common Salt.* Common salt is also used as an admixture and has been especially advocated for use with limestone screenings. The reason advanced in this case is that salt when dissolved in water has the property of dissolving the fine particles of limestone dust at a rapid rate and thereby the cementing value of the limestone dust is rendered even higher than is the case when water alone is used. Also, dependence is placed in part on the added cementing properties provided by the salt re-crystallizing within the voids or interstices of the screenings. It is also stated that like calcium chloride, common salt or sodium chloride solution evaporates less slowly than water and the water films surrounding the fine stone particles help to bind them together. This moisture is particularly effective during the compaction stage under traffic and the density obtained in such roads is as great as in Portland cement concrete. The salt may be applied by blading it into the screenings to the amount of 2/3 lb. to 1 lb. per sq. yd. per inch of depth. The top three inches only need be salt-treated. Excellent results have been obtained with salt mixed with limestone screenings and surfaces of high supporting value have been obtained.

Neither salt nor calcium chloride treated screenings surfaces can be expected to resist the abrasive action of a large amount of traffic, but they should serve as excellent bases when the time arrives to cover them with bituminous surface treatments.

### Bituminous Stabilized Screenings

Screenings or quarry waste mixed with bituminous materials have been used successfully for base construction. The procedure in such construction is first to use a gradation of screenings which will result in maximum density when rolled. The gradations previously given are excellent for this purpose. If there is not sufficient dust present, clay may have to be added. Then the screenings must be thoroughly mixed with water. Just the right amount of water to create maximum density and no more is important. The presence of water makes it possible to mix with the screenings the rather low percentage of bituminous materials required to render the mixture low in absorptive value. Without the water it would be practically impossible to mix the bituminous materials in the small percentages used, for the high percentage of dust would cause balling within the mixture and the coarser fractions would receive no coating whatever. Only enough bituminous material is used to waterproof the fine dust and after the mixture is compacted and the water is allowed to dry out, the resulting mixture is almost completely non-absorbent.

In a screenings mixture of say 3/8 inch maximum size, from 3½ to 4 per cent of bituminous material is advisable. Various forms of bituminous cements have been tried but it seems that a special form of asphalt emulsion having a comparatively hard asphalt base has been most extensively used. Rapid curing cut-back asphalt such as the Asphalt Institute specification RC-2 and also tars have been tried with promise of success. The resulting screenings slabs thus waterproofed are rather rigid and have considerable slab strength. They, however, are quite brittle and the question of whether they have subsequent self-healing properties is in some doubt. This possible defect could be improved, however, by the use of somewhat more bituminous binder than ordinarily used. Thus a somewhat greater amount of water proofing would be provided, and thicker films of bitumen would result.

The relative effects of different gradations, different bituminous materials and the inclusion of clay in the mix have been studied in our laboratory by the aid of our circular track and these results are described in detail in our report before this convention. Let it be pointed out that just as in the case of plain screenings, or those treated with salts, the best results are obtained with bituminous admixtures when the screenings are well graded in accordance with the gradations approaching those previously given for maximum density.

In construction it seems advisable to use plant mixes for the greatest uniformity, preferably mixed in a pug mixer. The procedure is to first introduce the proper amount of water into the mixer with the screenings and mix to uniformity; then the bituminous material is finally mixed. The amount of water must be determined by trial. Too little water renders uniform mixing of the bituminous material difficult, too much water produces a condition resulting in separation of the bituminous binder with a resulting uneven coating of the aggregate. The mixture may be laid and screeded off in the same manner

as concrete. It must be allowed to dry out to some extent before rolling and this may require from one day to a week or more, depending on the weather. The final result is a waterproofed base of high supporting value. This base must be protected from traffic, however, for it is not intended as a wearing surface.

A number of different kinds of bituminous wearing surfaces may be used making use of the fine sizes of stone. Thus, a surface treatment of bituminous material with fine crushed stone as a cover, a mixed-in-place treatment, or any one of a number of premixed materials may be used. Stone sand mixed with emulsion or cut-back asphalt will make an excellent wearing surface and of course the more expensive, thicker surfaces of cold-lay pavements may also be used. It should be remembered, however, that a bituminous stabilized screenings base is a relatively inexpensive base and is not intended to replace the more expensive, more durable forms of stone bases.

Portland cement as a binding medium should also offer excellent possibilities for use with screenings in stabilized base construction. A relatively weak concrete would result which, however, should show sufficient slab strength.

### Highway Shoulder Construction

Screenings stabilized in accordance with any of the methods previously mentioned are exceedingly valuable for shoulder maintenance of highways. The subgrade support under the edges of pavements depends on keeping the subgrade dry and a waterproofed shoulder undoubtedly adds to the life of any pavement. Further, rutting of the shoulders is prevented and extra travelable surface is provided, thus increasing highway safety. The use of screenings for this purpose cannot be too highly commended.

### Frost Boils

During times of Spring break-up of inadequately constructed roads, many ways have been tried to carry the traffic and to strengthen the road in spots where the "frost boils" have occurred. It is questionable if there is any better material for this purpose than stone screenings or stone sand. These have been successfully used where other materials have failed. The reasons can be ascribed to:

The high stability of a screenings layer due to the angularity and interlocking of the particles and, in part, to the cementing characteristic of the stone dust.

Also, to the fact that the stone dust, unlike clay, has no plastic properties when it is wet. This high stability results in sufficient strength to spread the load over a wide area of the soft subgrade and any tendency for it to flow upward is resisted by the strength of the screenings layer.

### Sidewalk Construction

The construction of sidewalks along the highways has gained momentum during the past few years, particularly in the more populous sections of the country. Some 500 miles of sidewalk were constructed along the highways of Massachusetts in 1936. There were two main objectives in this construction work:

(a) To reduce accidents to pedestrians.
(b) To provide employment for unskilled labor.

One of the effects noted has been an increase of property values along state routes where sidewalk improvements have been made.

Screenings as a base course for sidewalks are ideal. A compacted layer 4 to 6 inches in thickness should be sufficient. These screenings should preferably be given a gradation for high density, mixed with water in a concrete mixer where feasible, screeded off and rolled in place. They may also be laid in place between headers, sprinkled with water if not sufficiently damp and rolled. The screenings may also be mixed with bituminous materials in a mixer to create a waterproof layer using the same methods as in stabilized base construction previously described.

A wearing surface should be used on this stabilized screenings base. This may consist of any of the recognized types of fine graded, hot or cold asphaltic mixes, preferably laid to a compacted thickness of 2 inches.

### Screenings Layer as Sub-Base for High Type Pavements

There is a growing belief among highway engineers that stabilized base construction is of value in many locations when used under high type pavements. A short discussion of the functions of such a layer may be enlightening.

Wheel loads produce the highest concentration of pressures directly on the wearing surface. At greater and greater depths beneath the surface, these vertical pressures are reduced in magnitude and are spread over greater and greater areas. It is desir-

able that at the bottom of the pavement or the top of the subgrade, these pressures be so reduced that the soil will resist them without appreciable deformation. Too much deformation or movement of the soil under pressure results in undue bending of the wearing surface which may finally result in surface failure. Soft subgrades will withstand only low pressures and, consequently, the pavement must be so designed as to bring about greater spread of the pressures due to wheel loads than when the subgrade has high resistance. Here is a condition where a screenings sub-base is of very great value. It is not at all necessary that the pavement structure have the same strength or pressure spreading ability throughout its depth. On the contrary, it would be more economical to so design the surface that the layers of different depth shade from the strongest at the surface to the weakest next to the subgrade.

A screenings layer plays other functions also when used as a sub-base. Under a macadam base such a layer serves as a blanket or shut-off layer and is a very effective means of preventing a clay subgrade from being forced upward into the large voids between the stone. Wet clay is an excellent lubricant and precautions should be taken to keep it out of a macadam base. That screenings will accomplish this purpose has been amply demonstrated not only in practice but by means of laboratory tests in our own laboratory.

Under concrete, screenings probably serve several very useful purposes as follows:

(1) Such a layer should aid in extracting part of the mixing water from the freshly deposited concrete, thus reducing the effective water-cement ratio and thereby adding to the strength and durability of the concrete.

(2) Screenings have low capillary action and the quantity of water which is fed upward vertically through the concrete is greatly reduced. This continuous vertical stream of capillary water evaporates at the surface of the concrete and if any salts have gone into solution from the concrete itself or from the subgrade they may be concentrated within the surface pores and this is thought to be a contributing cause of surface weakness and surface scaling. A non-capillary layer of screenings thus should be of benefit in increasing the durability of concrete road slabs. Clean screenings free of dust would seem to be best fitted for this service.

(3) Clay subgrades shrink and swell with changing moisture conditions. A cushion of screenings would tend to retain more constant support under the slab for such a layer suffers practically no change in volume owing to moisture changes.

Laboratory evidence supports the idea of the beneficial effects of screenings under concrete roads, especially in increasing their durability. This use is surely worthy of extended trial.

### Screenings and Other Quarry Fines in Road Surface Construction

The use of fine crushed stone in most bituminous surface mixtures is well known and of proven merit. Thus, fine crushed stone is recognized as the aggregate of greatest merit in such mixtures as fine and coarse graded hot bituminous concretes, various cold mixes such as the liquefier types, the emulsion types of mixtures and many others. There is one fine graded type, however, which for some reason has not made use of crushed stone to any great extent, namely, the sheet asphalt pavement. Here, natural sand has been most widely employed. Stone sand not only makes an excellent substitute for natural sand for sheet asphalt construction, but should give superior results. Certainly, much higher stability is possible with angular stone sand in sheet asphalt than with more rounded natural sand. This fact has been shown by Hubbard-Field stability tests reported by us. Producers of stone sand should not overlook this potential market for stone sand for use in hot mix sheet asphalt.

*Stone Sand Cold Bituminous Mixes.* When chain-equipped traffic has caused wear and roughness to develop in bituminous surfaces, the question arises as to the best method of maintenance. Recently, a stone sand liquefier type of cold mix, making use of stone sand or dust-free stone screenings, has been very successfully used for this purpose. The mix may be applied by the use of a spreading machine and forms a smooth, non-skid, sandpaper-like finish and should be very durable under chain traffic. The details of such a mix recently laid in the District of Columbia are as follows:

| Aggregate Gradation | Total Per cent Passing |
|---|---|
| No. 4 | 100 |
| No. 8 | 60—90 |
| No. 50 | 0— 5 |

| Mix Proportions | Per cent |
|---|---|
| Aggregate | 90.5 to 94.6 |
| Liquefier | 0.4 to 1.5 |
| Asphalt cement | 4.5 to 7.0 |
| Hydrated Lime | 0.5 to 1.0 |

Such a mix should also make an excellent wearing surface laid on a bituminous stabilized base for use in sidewalk construction.

### Cover Material for Bituminous Surface Treatments

Quarry fines in the form of dustless stone screenings have, of course, been standard for use as cover material over bituminous surface treatments for many years. There probably is no better material for this purpose. Specifications for size differ in different localities and depend on the type of bituminous material and type of construction employed. For illustration, heavy, bituminous treatments applied hot require rather large cover stone as contrasted with the thinner cold application treatments which are applied in lesser amounts per square yard. There seem to be two schools of thought regarding the proper gradation of fine stone for cover depending upon whether the cover is merely broadcast over the bitumen and rolled, or whether it is to be dragged before rolling. If merely broadcast without subsequent disturbance before rolling, fine stone of one size seems best. On the other hand, when a graded stone is used, one containing a high percentage of fines, it seems imperative to resort to dragging methods so as to thoroughly coat all of the stone particles before rolling. This method results in a very dense surface having excellent wearing qualities. The exact details of gradation will not be discussed here, but reference may be made to the recent standard for sizes of the Division of Simplified Practice, issued June 10, 1936.

### Screenings for Waterbound Macadam

Screenings for filling waterbound macadam need hardly be mentioned, this use is so well-known. Let it be emphasized, however, that the efficiency of screenings for this purpose depends in large measure on the fine dust present. A stone having inherently high cementing properties may actually have no such properties, unless fine dust is present. On the other hand, other screenings made of stone having inherently low cementing properties may serve as an excellent binder if enough fine dust is present. This has been proven in our laboratory on several different occasions.

### Fines Used as Fine Aggregate in Concrete

Stone sand has been the subject for much discussion before this Association of late years and has again been discussed in some detail before this Convention. Good results have been obtained with properly prepared stone sand. The all important factors seem to be proper shape of particle and proper gradation. The more cubical or rounded the particle, the more workable the concrete will be with a given amount of water in the concrete mixture. Extremely flat and needle-like particles should be avoided and the industry would do well to look into methods of preparing stone sand which will result in more cubical shape.

Another important feature is gradation. Stone sand can be given a gradation ideal for the purpose for which it is to be used. A lean concrete requires a finer sand than a rich concrete and, frequently, a much more favorable gradation is possible with stone sand than with competing natural sand. This matter is discussed in our Bulletin No. 10 on Stone Sand. It is vitally important that strict attention be paid to these two details if the necessary degree of workability and durability of concrete are to be attained.

### Stone Sand for Mortar for Masonry Construction

Here is a field not to be regarded lightly. Fine stone sand containing a great deal of dust has given most excellent satisfaction for use in mortar. The strengths obtained have been excellent and the plasticity is a delight to the mason. More stone sand should be used for masonry construction.

### Stone Screenings and Stone Sand for Concrete Masonry Units

Included in the classification, "Concrete Masonry Units", are concrete blocks and bricks for building, concrete slabs and panels, floor beams, culvert rings and various other concrete units molded in a plant. The use of stone screenings containing considerable fine dust is beneficial in the lean mixes generally used for concrete blocks and other masonry units. Plasticity is imparted to the mix and denser and less porous blocks are obtained. Furthermore, tests have shown that higher strengths result in lean mixtures by the addition of screenings containing considerable fines up to 20% through the No. 100 sieve. Limestone screenings make a light colored block which is often considered very desirable. Screenings enable the block to better withstand handling immediately after removal from the form.

### Agricultural Limestone

Limestone screenings in various degrees of fineness are of course recognized for their highly beneficial

effect as an agent for neutralizing soil acidity and for making the soil more friable. The practice as to fineness differs in different sections of the country and there has been much discussion on the most desirable fineness to use. Fine dust becomes more immediately available as a neutralizing agent than coarser fragments, because of its extremely high surface area, but at the same time it costs more and the question of relative fineness becomes an economic one in which many factors must be considered, too complex in nature to be discussed here.

### Grit or Friction Material

Now that snow removal has become the general practice along with ice control, the use of gritty material mixed with salt or calcium chloride is widely practiced. Clean stone screenings have some advantage for this purpose. Their angular shape and gritty surface render them resistant to skidding. Their angularity should be helpful in aiding embedment in the ice; their dark color and heat-absorbent properties should also aid embedment; finally, when swept off the roadway, they will serve to build up and stabilize the shoulders.

### Miscellaneous Use

No doubt many more uses of a special nature will suggest themselves. Among some of them may be mentioned sub-ballast for railroads, fillers for paints, putty, linoleum, etc., granolithic for concrete floors and sidewalks, special decorative finishes for concrete and many others. Certainly, there are enough uses for quarry fines to make them a valuable portion of the entire production of a quarry.

In conclusion it will be obvious that no attempt has been made to cover the many details of desirable specification limits and methods of construction in which quarry fines may be employed. A complete discussion would require a lengthy paper covering each use. It is hoped, however, that a brief, general discussion, such as this, may suggest special uses and at least should be of some assistance in disposing of material which too often has been considered as a waste product having little value. Actually, the various quarry fines are not waste products. They are highly useful products and should be valued accordingly. In some instances, it may pay to install special processing equipment to produce fines having the properties necessary for particular types of construction.

## Twenty-First Annual Convention Enthusiastically Acclaimed an Outstanding Success

(*Continued from page 10*)

As the principal guest speaker at the Banquet, Mr. James A. Emery, General Counsel, National Association of Manufacturers, held his audience spell-bound with an exceptionally fine address entitled, "Industry and Public Policy." His talk was both entertaining and inspirational and we are very much indebted to him for making our Annual Banquet such an enjoyable affair.

The second and last speaker on the Banquet program was Major Eric Vonder Heide, listed as coming from Vienna and New York and scheduled to discuss "Humanities in Labor Relations." It was not until the concluding remarks of his address that the audience realized that he probably did not come from Vienna and New York and had certainly wandered far afield from his subject. As one of the outstanding humorists of the country, the "Major" certainly made a hit.

Patterned after the successful event of last year the Convention concluded on Wednesday evening with the Convention Cabaret. The floor show was excellently received, dancing taking place between halves of the show and following the second half until midnight.

In conclusion let us say to those who found it impossible to be with us at Cincinnati that it was one of our most successful and pleasurable Conventions, evidencing an industry united in its belief in the value of cooperative effort and certain in the knowledge that only through such means can the industry as a whole and its individual members continue to prosper.

## Quarry Property For Sale

The following described quarry property is offered for sale by the Liquidation Corporation, 702 Davenport Bank Building, Davenport, Iowa, and inquiries should be forwarded directly to them:

The site comprises approximately 250 acres of land, situated on the Mississippi River, about eight miles southwest of Davenport, Iowa, and traversed by main line railroad and paved highway. There is approximately ½ mile of river frontage, with dock for loading coarse aggregate.

There is now profitably operated on the tract a limestone quarry with a capacity of approximately 1,000 tons per day.

# The Use of Agricultural Limestone Under the Revised 1938 Agricultural Conservation Program[1]

By C. C. FARRINGTON

**Assistant to the Administrator, Agricultural Adjustment Administration**

◆ **Definite and important changes have been made in the Soil Conservation Program for 1938. These changes are comprehensively discussed by Mr. Farrington in the following paper which should prove of specific value to the producers of agricultural limestone.**

I APPRECIATE this opportunity of meeting with you and discussing with you the provisions of the 1938 Agricultural Conservation Program as they relate to the use of agriculture limestone.

At your convention a year ago Mr. Joseph Cox, of the Program Planning Division of the Agricultural Adjustment Administration, discussed with you the value of agricultural limestone in a national program for the conservation of the soil.

Over a period of years the Department of Agriculture, through its research and demonstration work and farmers' bulletins, has promoted the use of agricultural limestone. In 1936, however, the Department began a new type of activity designed to accelerate the adoption of improved farm practices, the value of which had been proved by years of experimental and demonstration work. This new activity involved the use of payments or grants to assist and encourage farmers to adopt these improved farm practices. These payments or grants are made under the Agricultural Conservation Program by authority contained in Sections 7 to 17 of the Soil Conservation and Domestic Allotment Act, approved February 29, 1936.

I believe it is only fair to say that the Agricultural Conservation Programs have been highly effective in bringing about the adoption of a number of improved farm practices. This is particularly true of the application of ground limestone as a means of promoting the growth of soil-conserving crops and improving pastures.

The use of agricultural limestone practically doubled between 1935 and 1936, and payments were made under the 1936 Agricultural Conservation Program on over one half of all of the agricultural limestone applied in the United States that year. Payment for the application of agricultural limestone was made under the 1936 program in 37 States and under the 1937 program in 38 States.

Provisions relating to the use of agricultural limestone as an approved soil-building practice are included in the program for 1938 and probably will be approved for each of the individual States except a few of those in the western part of the United States where the use of limestone is not generally recommended.

Estimates released by the National Lime Association indicate that about 6,300,000 tons of agricultural limestone were used in 1936 as compared with 3,300,000 tons in 1935. The use of agricultural limestone in 1936, therefore, was almost double what it was in 1935. It was also about 70 percent greater than it was in the year 1929. The sharp increase in the use of agricultural limestone in 1936 undoubtedly should be attributed largely to the 1936 Agricultural Conservation Program. As a specific example, one county agricultural agent recently reported that a few years ago he made a special effort to increase the use of limestone in the county but succeeded only in getting five tons used. In 1936 about 1,500 tons were purchased by farmers in the county and applied under the program.

The increase in the use of agricultural limestone in the United States between 1935 and 1936 was about 3,000,000 tons. The total amount of limestone with respect to which payment was made under the 1936 program was slightly more than 3,600,000 tons. This increase in the use of agricultural limestone in 1936 was general throughout the eastern part of the United States. An increase was recorded in prac-

[1] Presented at the Twenty-First Annual Convention of the National Crushed Stone Association, at Cincinnati, Ohio, January 24, 1938.

tically every State and these increases are closely related to the amount of limestone on which payments were made under the 1936 program. For example, in the northeastern States—the New England States and New York, New Jersey and Pennsylvania—payments were made on about 375,000 tons of limestone and the use of agricultural limestone was increased about 227,000 tons between 1935 and 1936. In the ten North Central States, extending from Ohio on the east to Nebraska on the west, payment was made on about 2,111,000 tons under the 1936 program, and the use of agricultural limestone increased about 1,945,000 tons. In the States of the East Central Region—Kentucky, Tennessee, North Carolina, Virginia, West Virginia, Maryland, and Delaware—payment was made with respect to approximately 1,103,000 tons, and the use of agricultural limestone was increased about 785,000 tons.

Comparable figures are not yet available with respect to the 1937 program, but reports so far received indicate a continuation of the increased use of agricultural limestone.

I assume that most of you who are engaged in the production of agricultural limestone are more or less familiar with the provisions of the 1936 and 1937 programs relating to the use of agricultural limestone. As you know, a soil-building allowance was established for each farm and producers could earn payments up to the amount of this allowance by adopting one or more of the various approved farming practices. Specific rates of payment were provided for carrying out these practices. For example, the usual rate of payment for the seeding of alfalfa in 1937 was $2.50 per acre. The rate for applying agricultural limestone varied somewhat by areas depending largely upon the average cost of limestone in the area. The rate in the North Central States was $1.25 per ton. The rate in the Southern States was $1.40 per ton. In the East Central States the rates varied from $1.50 per ton to $3.00 per ton and in the Northeastern States the rates varied, depending on the average cost of limestone in the county, from $2.50 to $5.00 per ton.

The 1938 program is similar in its essential features and in many of its details to the 1936 and 1937 programs. Some changes in form have been made which we feel will increase the effectiveness of the program but the objectives remain unchanged. These objectives, as most of you know, are the conservation and improvement of the nation's soil and the maintenance—insofar as is possible under present law—of farm purchasing power. These aims are inseparable to a large extent. We cannot improve our soil resources through better balanced farming without helping farm purchasing power. Soil improvement means a substantial shift out of the principal soil-depleting crops, corn, wheat and cotton, to the leguminous crops. In turn, this contributes to stability of agricultural production and to stability of farm income.

Under the 1938 program a total farm payment will be computed. The farmer will earn the total payment for the farm if his acreages of soil-depleting crops in 1938 do not exceed the soil-depleting goals or acreage allotments that are established for the farm and if the units of soil-building practices carried out equal the soil-building goal established for the farm. If the farmer plants an excessive acreage of soil-depleting crops or fails to carry out the required number of units of soil-building practices, the farm payment will be reduced. The rate of reduction for failure to meet the soil-building goal is $2.00 for each unit of soil-building practices by which the farmer fails to meet his goal.

For purposes of illustration, let us assume that in the case of a 100-acre farm a soil-building goal of 25 units has been determined. This means that if the farmer is to receive full payment and escape deductions, he must carry out 25 units of soil-building practices in addition to keeping the acreages of soil-depleting crops within the goals established for these crops. There are a number of practices which the farmer can carry out and for which he will receive credit in meeting the soil-building goal. Generally speaking, these practices are much the same as those for the 1936 and 1937 programs.

For example, credit at the rate of two units per acre seeded will be given for seeding alfalfa and other perennial legumes, and for seeding bluegrass. One unit credit is given for applying 300 pounds of 16-percent superphosphate to soil-conserving crops or to pastures. The rate of credit for the application of limestone will vary from area to area depending upon the average cost of limestone. In areas where the average cost of limestone to farmers is less than $1.50 a ton, the rate of credit is one unit for each 3,000 pounds of limestone applied. In areas where the average cost of agricultural limestone to farmers is between $1.50 and $2.50 a ton, the rate of credit is one unit for each 2,000 pounds applied. In areas where the average cost is determined to be between $2.50 and $3.50 per ton, the rate of credit will be one

unit for each 1,500 pounds of limestone applied. In areas where the average cost is determined to be between $3.50 and $5.00 per ton, 1,000 pounds of limestone will be counted as one unit, and in areas where the average cost of limestone is in excess of $5.00 per ton, 800 pounds of limestone will be counted as one unit toward meeting the soil-building goal. In many areas, an application of less than 1,000 pounds per acre of ground limestone will not be counted, and in some areas the maximum application for which credit will be given will be three or four tons per acre.

Final determinations have not been made with respect to the exact boundaries of all of the areas in which the different rates of applications of ground limestone will apply. On the basis of available information, however, it is probable that the areas will be about as follows:

The 2,000-pound-per-unit application will apply in the States of Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, South Dakota, Tennessee, most of Kentucky, and in parts of the States of North Carolina, Virginia, and West Virginia. The 1500-pound-per-unit application will apply in the States of Oklahoma, Texas, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, and parts of North Carolina, Virginia, West Virginia and Maryland. The 1000-pound-per-unit application will apply in New York and Pennsylvania, and in parts of Vermont, Massachusetts, Connecticut, Maryland, and Virginia. The 800-pound-per-unit application will apply in Maine, New Hampshire, Rhode Island, New Jersey, Delaware, and parts of Maryland, Connecticut, Massachusetts, and Vermont.

Under another practice included in the 1938 program one unit of credit will be given for applying 1,000 pounds of finely ground limestone (at least 90 percent to pass through a 30-mesh sieve) if such limestone is applied at the rate of not less than 500 pounds nor more than 1,000 pounds per acre. The rate of credit for this practice will be the same for all States in which this practice is approved. This practice is designed for those areas where it has been found that good results are obtained by applying between 500 and 1,000 pounds of finely ground limestone to legumes by drilling the limestone in at the time the crop is seeded.

The 1938 program contains another provision which may be of interest to many of you. The Soil Conservation and Domestic Allotment Act, under which the agricultural conservation programs are formulated, authorizes the Secretary to promote soil conservation by making of grants of aid as well as by making payments. Consequently, there has been included in the 1938 program a provision authorizing the Agricultural Adjustment Administration, whereever practicable, to furnish limestone, superphosphate, trees, seeds, and other materials to producers for use in carrying out approved soil-building practices. Thus far, no use has been made of this provision in connection with limestone. I am not in a position to say to what extent, if any, it will be employed in connection with the use of limestone in the future, or just how it will be used if it is found practicable in certain instances to furnish limestone to farmers as a grant of aid in lieu of a payment.

Thus far, phosphate is the only material that has been furnished to farmers under the Agricultural Conservation Program. In connection with the 1937 Agricultural Conservation Program an arrangement was entered into between the Agricultural Adjustment Administration and the Tennessee Valley Authority whereby triple superphosphate manufactured by the Tennessee Valley Authority was furnished to farmers by the Agricultural Adjustment Administration. The triple superphosphate thus furnished is a highly concentrated phosphatic fertilizer developed by the Tennessee Valley Authority for educational purposes. It averages aproximately 43 percent phosphoric acid or two to three times the phosphoric acid content of the usual commercial product. Farmers who obtained this triple superphosphate were required to pay the transportation and handling charges from Sheffield, Alabama, to the point of delivery. The amount of payments which farmers could receive for carrying out other practices on the farm was reduced in an amount equivalent to the payment which would have been received for the application of superphosphate had it been purchased and applied in accordance with the provisions of the program.

In general, the procedure was as follows: Producers who desired to secure triple superphosphate submitted their requests to the committee in charge of the administration of the program in the county. When requests acceptable to the county committee for as much as a carload of triple superphosphate were received, the requests were transmitted to the State administrative office for examination and approval. The State office then transmitted the necessary forms and shipping instructions to the Tennessee

Valley Authority. The triple superphosphate was immediately loaded into cars and shipped to the county in which the order originated. Upon arrival of the fertilizer, the producers obtained the phosphate by paying their pro rata share of the transportation and handling charges. The producer agreed to apply the material to pastures, alfalfa or other specified soil-conserving crops.

This arrangement proved highly satisfactory to all concerned. In the areas where triple superphosphate furnished by the Agricultural Adjustment Administration was available, the amount of phosphoric acid applied to soil-conserving crops increased sharply and a much larger percentage of the soil-building allowance was used for this purpose than would have been the case had the material not been furnished to farmers. The activities of the Tennessee Valley Authority, directed toward improving and cheapening plant food materials, determining their most effective use, and carrying the results of such experience to practical farmers, were made much more effective. Farmers in the area where this material was available became acquainted with phosphatic fertilizer in a new form and for new uses. The introduction of this new product to farmers may pave the way for the commercial development of a more highly concentrated commercial fertilizer. In turn, this may bring about reduced transportation and handling costs and result in increased use of plant food at lower costs to farmers.

There are several factors in connection with this project which are likely to be taken into consideration in connection with any future projects of a similar nature. First, the project involved the use of a product which was being produced in only limited quantities by commercial concerns. It thereby tended to acquaint farmers with the use of a new product, or rather an old product in a new, highly concentrated form which can be shipped much more economically than the usual commercial product.

Second, the furnishing of the material was an alternative offer to farmers, and no farmer was obliged to use the product furnished by the Agricultural Adjustment Administration. The offer of a payment for the application of purchased phosphate was available at all times. Thus, every farmer could choose between buying the material on the market and securing a payment from the Government, or getting the material from the Government and receiving no payment.

Third, the cost to the Government was approximately the same regardless of the procedure followed. The amount paid to the Tennessee Valley Authority was virtually the same as the sum which otherwise would have been paid to farmers for the application of the same amount of phosphoric acid to soil-conserving crops.

Fourth, this project seems to point the way to a partial solution of the credit problem which is so serious with farmers. Many farmers who want to cooperate in the program, and who need its benefits, are prevented from doing so because of lack of funds to carry out soil-building practices for which payment is made under the program. Payments for these practices ordinarily are not made to farmers until several months after their performance.

Fifth, to a large extent the material furnished to farmers represented an addition to, rather than a substitution for, superphosphate which otherwise would have been used. In areas where the triple superphosphate was used extensively in 1937 the amount of phosphoric acid applied to conserving crops was much greater than under the 1936 program when payments alone were offered.

Should a similar project be attempted with respect to agricultural limestone, I feel confident that the results would be similar. Any limestone furnished to farmers as grants of aid would, I believe, represent largely a net increase in the use of agricultural limestone.

In this connection I wish to quote from two letters which recently came to my attention. Both letters urged that limestone be furnished to farmers as grants of aid in lieu of payments.

One letter states:

> ". . . the main reason why the spreading of lime is neglected until so late towards fall is because so many of the small producers are short of funds and hate to borrow for so long a time.
>
> "I believe having a grant on lime would cause a more even distribution of lime during the year and thus agriculture would be benefited and more would use it that did not otherwise."

The other letter states.

> ". . . There is a strong desire for lime here due to good results but present prospects are for a scanty supply."

Such letters speak for themselves. They indicate clearly that the producers of agricultural limestone

(*Continued on page 31*)

# Report of the Committee on Agricultural Limestone

**The following report has been submitted to the Agricultural Adjustment Administration as an expression of opinion concerning the furnishing of materials as grants of aid in the Soil Conservation Program for 1938.**

IN CONNECTION with the administration of the Soil Conservation Program for 1938 it has come to our attention that under certain circumstances materials may be furnished as grants of aid in accord with the provisions of Section 7 of the 1938 Agricultural Conservation Program Bulletin. While it is true that this section provides for grants of aid only as an option or alternate to normal business procedure, it is the belief of our industry that the option of furnishing limestone as grants of aid should be exercised only when fulfillment of the purposes of the Act may not otherwise be attained. It is our belief that too general and too generous use of this option, insofar as it pertains to grants of limestone, would be detrimental to the best interests of our industry and its normal methods of distribution.

Lacking information as to the bidding procedure which may be established by the Administration in carrying out the provisions of Section 7, we realize that bids on agricultural limestone may be asked f. o. b. manufacturer's plant, f. o. b. point of rail destination, or f. o. b. farm site. To request bids on any basis other than f. o. b. point of consumption would, we believe, impose an undesirable hardship upon the producers of agricultural limestone. We also believe that such procedure would be directly contrary to the best interests of the farmer.

"Point of consumption" is here used to indicate farm site under conditions where agricultural limestone is available from producers having rail and/or truck delivery facilities. Where no deliveries of agricultural limestone are undertaken by the manufacturer for delivery to the farm site and all shipments are made f. o. b. rail siding, shipments f. o. b. rail siding should be construed as point of consumption.

The maintenance of open, competitive bidding in all cases where the Administration exercises its option of purchasing direct agricultural limestone under the terms of Section 7, must, it seems to us, be the desire of the Administration. Further, to follow such a procedure is decidedly advantageous to the farmer because it gives to him the advantage of purchasing under competitive conditions.

It is our earnest belief that open, competitive bidding can be maintained best where bids are requested on the basis of f. o. b. point of consumption.

The validity of our contention, we believe, is clearly demonstrated by the following example.

Let us assume first that bids are requested on an f. o. b. plant basis. In such event if the award were made on the basis of the lowest plant price submitted, it might develop that the plant of the low bidder was located so remotely from the farm site that the total cost f. o. b. farm site would, in fact, not be low to the point of delivery. Should a formula for determining transportation cost be used and the transportation cost so determined added to the plant price as bid to arrive at the total cost at the farm site, the effect would be to limit the supplying of the materials to plants located closest to the point of use.

On the other hand, should bids be taken f. o. b. cars on railroad sidings reasonably adjacent to farm site with transportation from car to farm site being provided either by the farmer or other agency, such procedure would deny the privilege of bidding to the producer of agricultural limestone not enjoying rail facilities.

This, it would seem, leads to the unavoidable conclusion that competitive bidding under truly favorable conditions can only be secured by the Administration's asking for bids f. o. b. the point of consumption.

In view of these circumstances, it is our earnest recommendation that the Administration, in purchasing agricultural limestone as grants of aid under the terms of Section 7, request bids f. o. b. point of consumption in order that competitive bidding under comparable conditions may be maintained.

Respectfully submitted,

Committee on Agricultural Limestone

RUSSELL RAREY (Chairman), Columbus, O.
J. R. BENT, Chicago, Ill.
W. W. DUFF, New Castle, Pa.
P. E. HEIM, Youngstown, O.
N. E. KELB, Indianapolis, Ind.
E. J. KRAUSE, St. Louis, Mo.
J. A. RIGG, Ft. Spring, W. Va.
H. E. RODES, Nashville, Tenn.

# Standardization of Stone Sizes[1]

By ALBERT V. BRATT

Testing Engineer,
Massachusetts Department of Public Works

◆ **For many years attempts have been made to bring about a national standard for sizes of stone and other aggregates. No state engineer has been more alert than Mr. Bratt in recognizing the desirability of standardization or more active in helping to accomplish it.**

AS TESTING Engineer of the Massachusetts Department of Public Works, I represent a consumer of over two million tons of crushed stone a year. I am, therefore, vitally interested in any financial burden that is a direct result of waste in the industry, and which must ultimately be borne by the purchasers of crushed stone. When I say industry, I refer to the consumer as well as the producer and distributor. The present practice of different consumers being supplied on demand, slightly different sizes of crushed stone intended for the same purpose is a decided waste in the industry.

As Chairman of the New England and New York Testing Engineers Association, I have, for several years, worked toward a standardization of the crushed stone sizes used for the same purposes in the northeastern area of the country. Although standardization has not been achieved as yet, definite progress has been made in that direction, and I am able to report that the attitude of the industry is at present much more favorable to the movement than it was several years ago or even one year ago. I can say, with confidence, that the outlook today is such that a well-directed campaign for standardization will be successful and to the benefit of all; a waste that has existed for years in this industry will be eliminated.

With this last thought in mind, I enthusiastically accept the invitation of your Association to present to a national organization of crushed stone producers and distributors my experience, my observations, and the results of my study of the Standardization of Broken Stone Sizes.

The purpose of my paper is to give whatever impetus I am able to this important movement initiated by the National Crushed Stone Association. I do not propose to take up your time with a discussion of the economic value of standardization. You men are in the business and you are well informed on the savings to be gained by the manufacture of uniform sizes of stone. I shall confine myself to a discussion of the situation as it is today; the barriers standing in the way of the movement; and the changes in procedure that I wish to recommend as a means of getting over these stumbling blocks.

I wish to make it clear at the beginning that by standardization of stone sizes I mean the standardization of the limiting sizes and gradation of stone as it is delivered for use on a project and measured by standard laboratory procedure. The modern trend in testing of coarse aggregates clearly indicates that the standard laboratory procedure will involve the use of square mesh sieves. That is the only yardstick. I do not, by statement or inference, advocate a standardization of plant screening equipment or crushing apparatus. Many variables enter into the crushing of stone; the geological nature of the stone determines to a large extent the kind of fracture. The type of screens, the pitch of the screens, and the speed of operation of the screens, all affect the gradation of the product. The efficient method of operating a quarry is rightfully a producer problem and should be determined by those men whose business it is to operate a quarry, and should not be directed by the consumer.

The January, 1930, issue of your Journal contains a report of the Sub-Committee for Standardization of Commercial Sizes of Crushed Stone. In describing a survey of the industry in this regard, the chairman of the Committee used the phrase "a chaotic state of affairs." A similar survey today would show that the situation is hardly any better. I readily admit that definite progress toward standardization has been made, but insofar as the multiplicity of sizes specified by consumers and used for the same work is concerned, insofar as the multiplicity of systems of nomenclature is concerned, and insofar as the use

[1] Presented at the Twenty-first Annual Convention of the National Crushed Stone Association, at Cincinnati, Ohio, January 24, 1938.

of the square and the round mesh sieve in testing crushed stone is concerned, chaos is probably still the word to be used in describing the state of affairs today. The natural question is why has the effect of this movement on the industry been so slight? And what can we do to achieve and really obtain the benefits of standardization?

The standardization of crushed stone sizes could be effected by any one of three methods.

First: The producers could, through efficient organization, make available only standard sizes of their product, thus forcing all consumers to adopt specifications and construction methods adaptable to these standard sizes. There are many obvious objections to this radical procedure. We may immediately dismiss it as impractical for it is directly opposite to the primary purpose of any industry; namely, to produce material that satisfies the consumer.

Second: The consumers could, through a representative organization, agree to and adopt uniform specifications for crushed stone sizes. This procedure has one serious objection. The sizes adopted as standard would not necessarily be based upon quarry operation efficiency. Although I do not believe it likely, it is entirely conceivable that the standard sizes of stone decided upon in this manner could result in sufficient waste sizes and recrushing operations to lower the present efficiency of operation of quarries.

Third: The consumers and producers could, through cooperation, agree upon the sizes of stone to be manufactured and used as the standard product of the crushed stone industry. This method is the only practical one and it is the one being followed by your Association in its work at the present time. If this method is practical, and it seems to be, then how can we best proceed in accordance with it?

It is natural that a movement of this kind should find as it sponsors the commercial producers and distributors of crushed stone. In sponsoring any movement you must first have enthusiasm and I believe that you have plenty of that; second you must direct that enthusiasm in accordance with a definite plan. I am not so sure that some of your enthusiasm isn't haphazard. In explaining this last statement, let me recall an incident.

I had occasion, at one time, to talk with a producer with many years' experience in the industry. We talked of standardization, and this producer was highly in favor of it, he had many excellent ideas on the subject, and he impressed me as being well informed on the movement under way. I brought up the subject of the work of the National Crushed Stone Association, and the promulgation of the Joint Technical Committee's recommended sizes of aggregates by the Division of Simplified Practice. I was amazed to find that this producer and prominent member of the National Crushed Stone Association did not know what the Division of Simplified Practice was, and was not familiar with the Simplified Practice Recommendation for Coarse Aggregates. He did say that he remembered having heard of it and he probably did, because his company accepted it prior to its publication.

I relate this incident merely to emphasize the point that the standardization of stone sizes is by no means a simple task, and we can eliminate a good deal of confusion by having a little bit of standardization in the work that is being carried on to solve the problem.

Assuming that the enthusiasm for this movement is properly directed by a well-organized plan, then the next step is to extend this enthusiasm to the consumer. It is in this step that a serious error has been made by many of you who have actively participated in this work. When you advocate the standardization of crushed stone sizes, you are asking primarily for a change in the sizes now in use, although the change may be slight. In presenting this request, the picture is often painted as being a compromise on the part of the consumers, or as an agreement on the part of each consumer to give a little and use a product just a little different than he now uses, and presumably, he now uses what he thinks is best. The reason given for the recommendation is to make the sizes of stone standard throughout the region. To my mind, that is a very poor start in gaining the cooperation of the consumer and arousing enthusiasm in him. In my experience I have never met a consumer that showed very much enthusiasm for compromising or giving a little in regard to his specification for materials, especially when he has experienced no difficulty in getting the product as he desires it.

To properly create enthusiasm in a consumer you should set forth clearly and definitely all the facts concerned in the standardization of crushed stone sizes. You should set them forth so that the consumer can, through his own reasoning, decide that the use of the standard sizes is preferable to the use of his present sizes, and being preferable, he will advocate a change. In other words, he will be in favor of standardization; he will give his cooperation; and he will lend enthusiasm to the movement. I realize

that this sounds easier than it really is in practice, but it is entirely feasible for if it were not, there would be no logical reason for standardization. That is, if you cannot produce a convincing argument of the superiority of the use of standard sizes over the use of the present multiplicity of sizes, the movement will die out, and it should. I earnestly urge you, therefore, to immediately abandon the idea of presenting standardization as being the result of compromise and conciliation. Present it rather as being the logical choice of the consumer, as a step in the advancement of construction procedure.

In Public Works, the consumer may be considered to be the Construction Engineer, when it comes to deciding upon the sizes of crushed stone. In order that we may better be able to present the facts concerning standardization, let me describe briefly for you the normal reactions and attitudes of the construction engineer.

It is the intention of every construction engineer to benefit by his experience and study, and to continually develop his procedure for using and selecting construction materials. He is ever striving to build better structures and to build them more economically. The superior structures of today are the results of improvements based on the experience of building structures in the past.

The aim of every construction engineer is to gain the good will of the public he serves. When he builds a structure that is superior to any of its kind that he has built before, he enjoys the favorable comment of the public, and he does one thing more, he assumes an obligation to henceforth construct all structures of this kind at least equal to this one in beauty, durability and design. As soon as he goes backward and builds a structure that is inferior to similar structures now in existence he is subject to adverse publicity and nothing is quite so undesirable in public works as is adverse publicity. It is very essential, therefore, that the construction engineer develop his specifications to go along with his latest construction procedure, and it is important that he modify his specifications only when the facts clearly indicate that better results are to be obtained. The refusal of a construction engineer to alter his specifications is most likely based upon careful deliberation and reasonable caution, and not, as you sometimes suspect on his stubbornness and undue satisfaction with the present specifications. And that brings us to the nature of specifications.

The private consumer can purchase materials from the producers he chooses and can demand satisfaction or take his business somewhere else. In public works all producers must be given equal opportunity to share in the business. This means that the construction engineer must specify clearly and definitely just what he wants. I do not mean to infer that the producers are any less fair in their dealings in public works than in private enterprise, but the very nature of the set-up is such that any product conforming to the existing specifications must be acceptable to the consumer. I have never met the producer that wouldn't protest if his material was rejected for not meeting specifications. Rejecting material that meets specifications is out of the question. And yet, specifications have been written that, through some unforeseen loophole, have included materials that were inferior to the material the engineer had intended to specify, and such specifications are changed to exclude that unsatisfactory product. Nearly all specifications now in use have gone through several minor changes of this type. The other common cause for changing specifications is a more or less modernizing process. The specifications are modified so as to conform to the newest construction practices. Note carefully that the changes made in both cases are based upon the experiences of the engineer. The construction engineer has schooled himself to change his specifications when the facts, as he knows them, lead him to decide that a change is desirable. In standardizing stone sizes, you are asking that a modernizing change be made in the existing specifications.

In sponsoring this standardization movement, it is clearly the responsibility of the producers to properly and completely present the advantages to be gained by the consumer in adopting standard sizes of crushed stone. To date, this point has been neglected. You are asking the consumer to change his present requirements for a product that he is now using through choice, and which he has no difficulty in obtaining. The consumer rightfully wants to know, why?

For example, in the Simplified Practice Recommendation for Coarse Aggregates, there are listed seven specific advantages to the producer, seven specific advantages to the jobber, wholesaler and retailer, and three for the consumer. These three are pretty intangible. The second one "Better Service in Delivery and Repairs" can be discounted in Massachusetts for the service there is entirely satisfactory. That leaves two for the consumer as against seven for the producer and seven for the distributor. Certainly there are more advantages to the consumer

than that, and I believe it is essential that you present them all.

Furthermore, the facts concerning standardization should include more than a statement of the advantages. The type of men to whom you are directing these facts demands that you present the underlying problems and methods of commercial quarry operation that make the production of the existing multiplicity of sizes an inefficient process.

Many of you may have expected that in a paper of this sort, I would recommend several primary sizes for adoption as standard sizes of crushed stone. I am convinced that this decision should be the result of the efforts of a representative group of producers and consumers; such as the standing committee referred to in the Simplified Practice Recommendation R163-36. I am concerned more with the proper method of getting the cooperation and enthusiasm of the entire industry behind the movement. The exact limiting sizes and exact range in size is not as significant as the proper gradation of the product and the uniformity of successive shipments of that product. It is entirely conceivable that several sets of primary sizes could be worked out, each with equal merit for use in construction. The important point is that agreements be reached, and certain sizes of stone be made standard, and all other sizes be considered special. It is equally important that the purchasers of special sizes bear all of the additional cost involved in making the special sizes.

In conclusion, let me review briefly my recommendations. It may appear that I am placing the blame for lack of success in this movement at the door of the producers. Such is not the case. My only intention is to discuss with you the situation as it is today; and being an organization of producers, I have attempted to point out some of the mistakes you are making as they appear to me, a Testing Engineer, with a favorable attitude to the movement of standization. I wish to take this opportunity to compliment your Association on the work it has initiated and express my confidence that you will achieve your goal.

First, I recommend that you make available to the consumer all the data concerning the question of stone sizes. This data should be definite and sufficiently complete to allow the consumer to understand the different phases of the movement, and to reason for himself the advisability of adopting standard sizes. You should present answers to such important questions as:

1. How much is standardization going to reduce the price of the product?
2. How much saving is there going to be for the producer that has no interstate business?
3. If standardization is general, are you going to continue to make the old sizes for the few who request them? If so, who is to bear the expense?

Second, I recommend that you show sufficient evidence that the industry, as a whole, will support the movement once agreements are made, thus assuring the consumer that he will reap the maximum benefit, and not be left with whatever disadvantages he may experience by the change, and none of the promised advantages.

Third, I recommend that this movement be properly presented as a campaign to show the consumer that the use of standard sizes is preferable to his present procedure in selecting stone sizes. Above all, abandon any reference to this movement as a compromise or conciliation on the part of the consumer. It is true that the sizes adopted will be determined through conference and probably argument, but those participating in such a conference will be assured, at the beginning, that the adoption of the standard sizes agreed upon will be a step in the advancement of the construction business, and so will have a real incentive to reach an agreement.

I wish to say now, as a testing engineer, that I believe that one of the best advantages to the consumer, in using standard sizes, (and it isn't mentioned in the Simplified Practice Recommendation), is the valuable comparative data that will be made available. The performance records of structures will be comparable as far as the coarse aggregate is concerned. The data available here would result in improvements in the methods of construction to such an extent that, in a very short time, superior structures would be built with the standard sizes of stone than were ever built before.

I believe that the standardization of crushed stone sizes is both practical and desirable, and I trust that I have given at least a little momentum to the movement.

I thank your Chairman and your Association for the opportunity to present my ideas on this most important subject.

# Recent Trends in Accident Occurrence At Quarries Producing Crushed Stone[1]

**By W. W. Adams**

**Supervising Statistician, Bureau of Mines, U. S. Department of the Interior**

**◆ Accident prevention has long been a primary objective of the Association and has been greatly encouraged through the annual safety contest conducted under the supervision of the U. S. Bureau of Mines. The collection and analysis of accident statistics come directly under the supervision of Mr. Adams. Better than any other man in the country, therefore, can he discuss recent trends in accident occurrence.**

A SUBSTANTIAL increase in the accident-frequency rate for the crushed-stone plants enrolled in the 1936 safety competition of the National Crushed Stone Association led your Administrative Director, Mr. J. R. Boyd, to request me to bring the matter to your attention at this convention. This I gladly do, and in doing so have the pleasure of stating that the record for 1936 appeared unfavorable only when compared with that for 1935, when the rate was exceptionally low. The 1936 record was not bad when compared with that of the other years since this Association began its safety activities about 11 years ago. What the reports for 1937 will show we do not yet know, as returns for that year have not yet been sent to the Bureau by the operating companies; hence we cannot tell at this time whether the upturn in the accident curve in 1936 was limited to that year or whether it continued through 1937.

The 1936 accident-frequency rate for the plants enrolled in the Association's safety contest was 31.4 per million man-hours of exposure, an increase of 49 percent over the group rate of 21.1 for the previous year's contest. The rate for 1936 represents the combined experience of fifty open quarries. Four other plants were also enrolled in the contest, but they were underground mines; hence, for comparative purposes, they are excluded from the present discussion.

What caused the accident rate for 1936 to rise so much above that for the previous year? Did newly enrolled companies contribute to the increase? Did any of the plants in the previous year's contest fail to enroll? If so, what effect did their withdrawal have on the general rate for 1936? An examination of the reports from all of the companies will help to answer these questions.

The enrollment for 1936 included 15 quarries that had not been enrolled in 1935. Eleven plants that were in the previous year's contest did not re-enroll in 1936. Thirty-five plants participated in the contests of both years. Here, then, are three groups whose records must be examined.

The 11 plants that did not enroll in 1936 had a rate of 23.1 in 1935, almost as low as the general rate of 21.1 for that year and much lower than the rate of 31.4 for 1936. We know from the annual reports of these companies that their accident rate in 1936 was 13.2. If these 11 plants had enrolled in 1936, the general rate for last year would have been 3.3 below the actual rate; in other words, the rate would have been 28.1 instead of 31.4, hence the loss of these 11 plants accounts for about a third of the rise in the accident-frequency rate of 1936 over 1935.

The 15 new plants that enrolled in 1936 had an accident rate of 32.4, slightly higher than the general rate for that year. These new plants brought with them a combined experience that contributed, in some degree, to the higher group rate for all enrolled plants in 1936. They contributed 1.6 or about one-sixth of the entire increase.

The remaining portion, about one-half, of the increase in the accident rate was chargeable to the 35 plants that participated in the contests for both years. The rate for these plants rose from 20.2 in 1935 to 30.8 in 1936, and it is in this group, therefore, that we should look for the principal causes of the rise in the accident rate for the contest as a whole in 1936.

[1] Presented at the Twenty-first Annual Convention of the National Crushed Stone Association, Cincinnati, Ohio, January 26, 1938.

Reports covering the 35 identical plants showed that 7 of them had no accidents in either year, 11 reduced their accident rates, and 17 had higher rates than in 1935.

Five classes of accidents were outstanding in showing higher accident rates in 1936; they were, as classified in the Bureau of Mines standard list of accident causes, "falls or slides of rock or overburden", "haulage", "drilling", "machinery" other than drills, and "falling objects". The combined rate for these five causes increased from 6.8 to 19.4 per million hours of exposure. Substantial reductions in the rates were shown for "hand tools" and "falls of persons".

I may appropriately do no more than point out that these five classes of accidents were chiefly responsible for the 49. percent rise in the accident rate for 1936 over 1935, among the companies enrolled in the crushed-stone safety contest. What to do about it can best be determined by the safety engineer at each plant.

Attention has already been called to the fact that 11 plants that participated in the contest of 1935 did not re-enroll in 1936. One or two of these plants may have ceased to be members of the Association, and one of two of them were not active in 1936, but plants are sometimes withdrawn from the contest because officials become discouraged when an accident occurs early in the year and they realize that their chances of winning a safety trophy have been destroyed. We urge all companies to remain in the contest from year to year, regardless of whether their accident records are good or bad. Two strong reasons would seem to suggest such course: First, continual competition in accident prevention is one of the most effective methods of promoting safety; second, companies in the contest are helping to build up a statistical record of the accident experience for the crushed-stone industry that will stand the industry in good stead in the presentation of claims for equitable compensation and insurance rates in hearings before State legislatures and State compensation commissions. Such a record is most convincing if it is built up before there is need for it, before controversial questions and legal issues arise, and it is well that the record cover as many companies as possible so that it may better represent the crushed stone industry. The importance of that industry is such as to warrant the development of a distinctive crushed-stone-industry accident rate, and keeping such a rate up to date from year to year to keep pace with changing conditions. Each plant enrolled in the Association's yearly safety contests helps in a constructive program designed to benefit the industry as a whole.

Having singled out the claasses of accidents that were chiefly responsible for the higher rate in 1936, it may be stated, without in any sense apologizing for the record of that year, that the rate for 1936 was 23 percent lower than the rate for the first year's contest 11 years ago, it was 47 percent lower than the second year's contest, and it was 29 percent lower than the third year's contest. Altogether, the 1936 rate was lower than that for 6 of the preceding years and higher than that for 4 preceding years.

Comparison of the accident rates for the companies enrolled in the Association's safety competition with the rates for crushed-stone companies in general is always favorable to those companies that participate in the contest. This statement applies not only to 1936 but to all other years during which the contest has been conducted. It is also true that plants that have enrolled every year since the contests were started 11 years ago have always had a lower accident rate than that for the contest as a whole. Fifteen plants have been in the contest since the beginning; their favorable position has been maintained by a fairly wide margin every year, and their combined rate for the entire period is 49 percent lower on a frequency basis and 46 percent lower on a severity basis than for the contest companies as a whole (contest 38.0 frequency and 6.46 severity; fifteen plants 20.8 frequency and 3.59 severity). The frequency rate for these plants that have always been in the contest was 39 percent lower last year than 11 years ago. The rate for the contest as a whole was 23 per cent lower last year than 11 years ago.

Companies represented in the contest during the entire period of 11 years are the General Crushed Stone Company, the Marquette Cement Manufacturing Company, the North American Cement Corporation, the American Lime and Stone Company, and the Wickwire Spencer Steel Company. One of the 15 plants has operated without a lost-time injury for the past seven years, and during that time has worked 673,899 man-hours; this is the No. 5 & 6 quarry of the North American Cement Corporation and it is located near Martinsburg, W. Va. A second quarry in the same group has been active without a lost-time accident during the past four years and during that time has worked 481,774 man-hours; this is the quarry of the Marquette Cement Manufacturing Company at Cape Girardeau, Mis-

souri. These two quarries almost tied for first place over the entire 11-year period, the accident-frequency rate per million man-hours worked for the 11 years averaging 4.66 for the North American plant and 4.77 for the Cape Girardeau plant.

In addition to the crushed-stone safety contest the Bureau of Mines conducts several other safety competitions, one of which covers plants engaged in the manufacture of lime, including the quarrying of the stone. This contest is conducted in cooperation with the National Lime Association, just as the crushed-stone contest is conducted in cooperation with the National Crushed Stone Association. The enrollment in the lime contest is slightly smaller than that in the crushed-stone contest. The accident-frequency rate for lime was 21.1 in 1936 compared with 31.4 for crushed stone.

Both of these rates are much higher than the rate for the cement industry, which, according to information published by the Portland Cement Association, was 7.6. The cement rate was therefore only a third as high as that for lime and about a fourth as high as that for crushed stone. However, the cement plants have been engaged in annual safety competitions over a much longer period than have either the lime or the crushed-stone plants and they have reduced their accident rate to a very low figure, one that is often referred to as a goal which other industries might hope to attain. There is no reason for thinking that producers of crushed stone may not do as well with equal effort over an equal period of time.

## Recent Visitors to the Washington Office

IT WAS a pleasing interlude from the usual routine of the Washington office to receive a visit in the week of February 14 from William F. Quinn, Superintendent of Plant No. 3 of the New Haven Trap Rock Co. located at Rocky Hill, Connecticut, and Frederick H. Edwards, Jr., Superintendent of Plant No. 6 of the same company from West Cheshire, Connecticut. Messrs. Quinn and Edwards drove to Washington for a week's mid-year vacation and during that period managed to see most of the outstanding attractions of the Nation's Capital. In addition to visiting the halls of Congress, Mt. Vernon, and various public buildings, perhaps the high spot of their week's stay was a trip in the Goodyear "blimp", "Reliance", over Washington and the territory in its immediate vicinity. Enthusiastic in their comments concerning the advantages of viewing Washington by air, they highly recommend this means of obtaining a comprehensive picture of the layout of the city.

WILLIAM F. QUINN

*Supt., Plant No. 3, New Haven Trap Rock Co., Rocky Hill, Conn.*

FREDERICK H. EDWARDS, JR.

*Supt., Plant No. 6, New Haven Trap Rock Co., West Cheshire, Conn.*

Opportunity was taken while they were in the city of visiting the Association's offices and research laboratory where the routine procedure for testing aggregates and a number of the more technical investigations which are now under way were explained to them.

We trust that upon their return they were able to make a favorable report concerning their visit to Washington and that many other members of the industry from the Nutmeg State will seek an early opportunity to visit the Nation's Capital. A cordial welcome awaits all as not only do we enjoy acquainting visitors with the points of interest and beauties of Washington, but it affords us the opportunity of getting helpful information with regard to the problems of the industry as they are developing in the field. By all means let us urge that when visiting Washington, your first contact be with the Association offices. We are here to serve you and can perhaps make your stay somewhat more enjoyable.

# Highways of the Future[1]

**By WM. F. CALLAHAN**

**Commissioner, Department of Public Works, Commonwealth of Massachusetts**

*(In the absence of Mr. Callahan, Mr. Raymond W. Coburn, Construction Engineer, Mass. Dept. of Public Works, read his paper before the Convention.)*

◆ **What highway construction holds for the future is a subject which should be of very great interest to the crushed stone industry. Based on past experience with traffic trends future needs may be visualized and, as state highway commissioner of a state having historic experience in highway construction, Mr. Callahan is in an excellent position to predict future highway needs.**

THE scope of this paper, a description of Highways of the Future, is so large and so indefinite, that a gift of prophesy equal to that of the legendary Mother Shipton is needed to conceive of anything but the broadest outlines and even these may be in doubt in this rapidly changing world. When is "the future"? Certainly we cannot look forward indefinitely. In my opinion a forecast limited perhaps to the next twenty years is as far as anyone can conceive, when we consider the changes that have taken place in the last twenty years.

## Improved Sight Distances

What should our highway systems be like in twenty years? We can dismiss consideration of the great network of secondary roads. These should be extended tremendously and those now improved will need further improvement, but all but a small fraction will remain two lane roads differing from those of today only in higher standards of design, such as greater lane widths, improved alignment and particularly improved sight distances. The latter point is of great importance as the speed of traffic is, in general, not governed by the importance of the road or the volume of traffic using it, but by surface condition, alignment and character of roadside development. Lack of sight distance, unlike other features, has little effect on the speed of travel and therefore the sight distance provided must, for safety, be sufficient for the speed at which vehicles will ordinarily travel on the road which in turn is governed by other features.

## Major Changes in Main Trunk Lines

The major changes in the next twenty years, outside of cities, will be in roads which are considered the main trunk lines and which are but a small fraction of the total improved mileage.

Within a period of twenty years, no main through roads carrying large volumes of traffic will be considered adequate, except in sparsely settled territory, unless it is constructed as a double-barreled highway. In many places where conditions will permit, these highways will be laid out and constructed as a freeway. A freeway has been defined as a way to which an abuttor has no right of light, air or access, except at especially designated points.

## Cross Road Elimination

On these double barreled roads there will be no cross roads at grade, and where laid out and constructed as a freeway, no entering roads except at long intervals. Usually the entering roads will be limited to the connecting ramps at highway grade separations.

There are obviously difficulties in the way of such construction. Not only must each cross road be separated from the main highway by a bridge or some special treatment, but adjustments must be made where property is cut in two and a valuable piece of land is left with no access to a public way. This difficulty may be overcome in places by the construction of service or border roads.

These highways will bypass settled communities, either horizontally or vertically, and be connected to them with access roads. Where a freeway is built, lack of access to the road will discourage the unsightly and unpleasant type of development that now usually immediately follows the construction of a new road in thickly settled areas. Furthermore, freeways, in my opinion, will encourage and permit decentralization of population in the cities, in that people now living in congested areas will be enabled, within a given time, by means of a road of this type, to reach now undeveloped sections of the country

[1] Presented at the Twenty-first Annual Convention of the National Crushed Stone Association, at Cincinnati, Ohio, January 25, 1938.

which were previously inaccessible within that same period of time.

### The Cross-Section

The cross-section of such highways needs little comment. Opposing streams of traffic will, of course, be separated by a physical division, ordinarily wide enough and so graded and planted as to do away with headlight glare, and permit space for plowing snow in the winter. Highways having a large proportion of truck travel will have separate roadways exclusively for trucks. Lanes will be not less than twelve feet wide, with at least two paved lanes in each direction, and parking lanes will be provided so that there will be no stopping on the pavement occupied by moving traffic, a present prolific source of accident.

### Speed

These highways will be designed and built, if possible, to carry a safe speed of not less than sixty miles per hour, even if the laws prohibit such a speed. By so doing, there will be built into these roads a factor of safety for traffic using them at less than the designed speed, and wherever the highway has been built for a lesser speed, the traffic will be so informed by proper uniform signs, illuminated at night.

The real purpose of a freeway is not so much to get the maximum speed, but to keep the travel moving, and permit uninterrupted progress at the highest speed that is economically possible within the limits of safety.

### City Problems More Difficult

In cities the problem is more difficult, and no less serious. The solution for city congestion is to keep the travel flowing, and this means a freeway. In these locations the freeway idea will be carried out by means of elevated and depressed roadways, without access except by ramps at particular points. These freeways will extend across a city and out the other side, as opposed to the older idea of bringing a main highway into a city to a terminus where traffic is "dumped." Existing city streets, and particularly the roadway at ground level under the elevated roadway, will take the place of service roads that are used in rural areas.

### Future Highway a Freeway

My idea of the main highway of the future is therefore contained as far as possible in the word "freeway." The principles are everywhere the same, but the method of applying the principles will vary, whether in the city or the country, and from place to place, depending on local conditions.

The decision relative to the necessity of building and the location of these freeways will be made only after factual data have been obtained in the field from state-wide fact-finding surveys. The analysis of this data will not only determine where the freeway will be built, but it will furnish the necessary information for its proper design.

The highway system of the future will consist of a backbone of main through freeways, fed by a network of secondary roads constructed to the standards we now use for primary roads, and these in turn fed by tertiary and land service roads constructed to the standards we now use for secondary roads.

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## The Use of Agricultural Limestone Under the Revised 1938 Agricultural Conservation Program

(*Continued from page 21*)

and the administration have a mutual interest in any project that may be undertaken for furnishing limestone to farmers in addition to making payments to farmers who purchase the limestone. Such a project would mean a larger total volume and a better seasonal distribution of limestone deliveries to farmers. From the standpoint of your industry, this means a larger volume of business and perhaps lower operating costs per unit. From the standpoint of the government, it means wider adoption of an improved farming practice which will be highly effective in promoting soil conservation and efficient farming. From the standpoint of the farmer it will mean finer legume crops and pastures and freedom from a credit burden which is one of the most important factors in preventing more widespread adoption of soil-building practices.

Since we have a common interest in the increased use of agricultural limestone, I feel confident that the fine relationship between agricultural limestone producers and the Agricultural Adjustment Administration will continue.

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